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"Stock Markets' Integration Analysis"

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Abstract

Globalization brought increased attention to stock markets throughout the world. As a straightforward consequence of the economic integration between the European country members, the stock markets of these countries are expected to follow a path of steadily increasing integration due to the gradual intensification of the economic and monetary integration. However the establishment of EMU and the introduction of the common currency do not have the same effect on the European stock markets. The members of EMU were at different point of readiness when the final decision had been taken since many countries in EU were already taking part in other kind of integration initiatives. The main aim of this study is to analyze daily data of selected European stock markets in an attempt to point out significant changes in the degree of market integration among different stock markets using different econometric techniques.

Keywords: Market Integration, Stock Markets, Stock Return Correlations, Co-Integration and Related Tests.

JEL Classification: G14, G15, C01

1. Introduction

The foundation and the establishment of EMU in 1999 commence an era where both monetary and fiscal policies in the euro zone became more coordinated. Stock market prices represent the economic conditions in each country and thus stock markets in EMU should be more integrated as a result of more similar conditions across the countries (Ripley, 1973). Additionally, during recent years there has been a positive progress towards financial integration in the EU with the implementation of single market legislation.

The EU's stock markets are still governed by different legal systems and other major obstacles such as legal, regulatory, tax or technical obstacles to cross border activity within the EU result in some degree of segmentation.

To date, several methods have been developed in dealing with this challenge. The fields of international macroeconomics and international finance have developed different but related methodologies to test for financial integration, ranging from simple empirical methodology tests to more complex models such as time series models, asset pricing models and others.

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2. The Objective of this Study

The main objective of this empirical study is to verify whether the establishment of EMU affects the integration of the European stock markets and to investigate whether the integration of the European stock markets has increased after the EMU.

The theory of efficient markets suggests that if there are not imperfections, a stock market index reflects all available information, including any other kind of information contained in other stock exchanges indices. If national stock markets were integrated, the lags of the price adjustments in these stock markets would be reduced (Koch and Koch, 1991).

From a theoretical or an empirical point of view, many studies analyze the linkages among national stock market indices. The empirical results usually testify to significant correlation between markets located in near geographic areas. This is frequently attributed, among others, to a number of different factors such as the relaxation of controls on capital movements and foreign exchange transactions, improvements in computer and communication technology that have lowered the cost of cross border information flows and financial transactions and expansion in the multinational operations of major corporations. This globalization of financial transaction has meant that stock markets are becoming more synchronized and the adjustment delays in international prices are increasingly shorter.

3. Literature Review

In recent years, there has been an extensive scientific interest and research on testing and measuring interdependence of stock markets (Corhay et al., 1993, and Koch and Koch, 1993). Other studies on stock markets in EU have found much evidence for high degree of integration among major European stock markets in the late ‘70s and ‘80s (Taylor and Tonks 1989, Dickinson, 2000). Little evidence for low degree of integration among several European stock markets has been found as well (Chan, et al., 1997). The relationship among major European stock markets had weakened during the period 1990-1994 (Gerrits and Yuce, 1999). Additionally, previous work has shown the lack of interdependence across national markets, supporting the benefits of international diversification (Grubel, 1968, Solnik, 1995).

Correlation between stock market returns provides an alternative to complex modeling methodology, such as time-series models, asset pricing models etc., for checking evidence of integration, mainly due to its simplicity.

Several authors have investigated the link between business cycle synchronization, country return correlations and financial integration. Erb, Harvey, and Viskanta, (1994) have found some evidence that cross-equity correlations in the G-7 countries are affected by the business cycle. The same relationship has been noticed by Ragunathan, Faff and Brooks (1999), in the specific case between U.S.A. and Australian markets. Bracker, Docking, and Koch (1999) have found a statistically significant relationship between bilateral import dependence and the degree of stock market integration.

Dumas, Harvey, and Ruiz (2000) have taken the opposite view and have calculated the theoretical degree of return correlations both under integration and segmentation, after controlling for the degree of commonality of country outputs. They have found that the assumption of market integration leads to a better

explanation of the level of observed correlations than the assumption of market segmentation.

King and Whadhawani (1990), King, Sentana and Whadhawani (1994), Karolyi and Stulz (1996), and Bekaert and Harvey (2000) investigate time-varying linkages between international stock markets and find that correlations have increased when global factors dominate domestic ones. In addition, several authors have documented that correlations are much higher when markets go simultaneously down, further reducing the insurance effect from international diversification as in Longin and Solnik (2001).

4. Available Data and Methodology

The available data used in this study consists of the daily stock index closing prices of 11 of EMU countries[1] namely, Belgium (BEL 20), Germany (DAX 30), Greece (ASE 20), Spain (IBEX 35), France (CAC 40), Ireland (ISEQ), Italy (MIB 30), the Netherlands (AEX), Austria (ATX), Portugal (PSI 20) and Finland (FOX), the three members of the EU that refused to join EMU namely, Denmark (KFX), Sweden (OMX) and the UK (FTSE 100). The inclusion of Denmark, Sweden and the UK was necessary because these countries have strong linkages with EMU member states.

The sample period starts from January 1, 1995 when the last contemporary stock index was introduced in Italy and extends up to July 27, 2004 totaling 2497 observations for each series. All data was provided by the Bank of England.

Before proceeding, it is of interest to examine the hypothesis of a stationary series for the 14 EU's available stock market indexes. In this way, the weak-form efficient market hypothesis for each of the 14 stock markets is examined. As already noticed, various tests are nowadays being applied in order to test the latter hypothesis, with most widely utilized among them the unit root tests. Specifically, the unit root test of Dickey-Fuller (*Dickey and Fuller, 1979, 1981)* is the most widely used unit root test.

Let us consider the following AR (1) process:

$$y_t = \mu + \rho y_{t-1} + \varepsilon_t$$

Where μ (constant) and ρ are parameters and variable ε_t is assumed to be white noise. Series y_t is a stationary time series if $-1<\rho<1$. If $\rho=1$, the series are non-stationary. The Dickey-Fuller (DF) Unit Root Test, tests then the null hypothesis:

$$H_0 : \rho = 1$$

vs

$$H_1 : \rho < 1$$

However, the above-described simple DF test is valid only if the series are an AR (1) process. If the series are correlated at higher order lags the assumption of white noise is violated. In order to correct this restriction, the augmented Dickey-Fuller (ADF) test makes a parametric correction for higher order correlation by assuming that the series follows an AR (ρ) process, adjusting accordingly the test methodology. The Eviews econometric software package performs the widely used test, the Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) test.

[1] Luxembourg was excluded due to the lack of stock index price data. However that effect is not so big since it is the smallest stock market and is closely related to the German.

In this analysis, the ADF Unit Root Test is used in order to check the stationarity (essentially the non-stationarity) of the stock indexes for the 14 European countries. Since the series of stock indexes contain a trend it is decided to include both a constant and a trend in the regression line described above, in order to perform the unit root tests. The results from the 14 ADF Unit Root Tests are summarized in Table 4.1.

***Table 4.1*: ADF Unit Root Test Results on Stock Indexes for Each Stock Market**

Country	ADF Test Statistic	1% critical value	5% critical value	10% critical value
UK	-1.566197	-3.9672	-3.4142	-3.1289
Germany	-1.191458	-3.9672	-3.4142	-3.1289
France	-1.021715	-3.9672	-3.4142	-3.1289
Spain	-1.390643	-3.9672	-3.4142	-3.1289
Italy	-1.095407	-3.9672	-3.4142	-3.1289
Portugal	-1.087684	-3.9672	-3.4142	-3.1289
Ireland	-1.508940	-3.9672	-3.4142	-3.1289
Netherlands	-1.025832	-3.9672	-3.4142	-3.1289
Belgium	-1.471366	-3.9672	-3.4142	-3.1289
Denmark	-1.383805	-3.9672	-3.4142	-3.1289
Finland	-1.337519	-3.9672	-3.4142	-3.1289
Austria	-0.195072	-3.9672	-3.4142	-3.1289
Sweden	-1.234804	-3.9672	-3.4142	-3.1289
Greece	-1.037013	-3.9672	-3.4142	-3.1289

The null hypothesis of a unit root (i.e. non-stationarity of the series) is rejected against the one-sided alternative if the t-statistic (ADF test statistic) shown in column 2 is less than (lies to the left of) the critical values (in Table 4.1 critical values for 1%, 5% and 10% significance level are also shown). As we observe, all ADF statistics are greater than the 1%, 5% and 10% critical values, indicating that we have no reason to reject the null hypothesis of the test.

Having concluded that the daily stock indexes are not stationary series for each country, and in order to investigate the degree of integration of the European stock markets after EMU, a new series of first differences of stock indexes for each country for the purpose of this research it is used, defined as:

$$\mathrm{Re}\,turn_t = 100 * \left[\ln(Index_t) - \ln(Index_{t-1})\right]$$

Hence, the returns series are formed taking first differences of the logarithm of series indexes, multiplied by 100. Summary statistics are presented for the returns series for the 14 European countries in Table 4.2.

Columns 2-5 of Table 4.2 present the average daily return for each country, the standard deviation, skewness and kurtosis. A first look at the returns characteristics reveals that the distribution of the returns is almost symmetric, with skewness around zero, with a negative sign for almost all returns (except Belgium and Sweden). The large positive kurtosis (especially for Portugal, Belgium, Finland and Austria) indicates that the observations cluster more and have longer tails than those in the normal distribution. In order to verify the deviation from normality indicated from the Kurtosis statistics, columns 6-7 present the Jarque-Bera test statistic for normality in stock returns and the associated p-value of the test. Additionally, the last

two columns show the results of another normality test, namely the Kolmogorov-Smirnov test statistic and the associated p-value. As it is observed, both tests reject the null hypothesis of the normality distribution for the returns for all countries at a 1% significance level (p-value<0.01).

Now, once again ADF Unit Root Test is utilized in order to verify that the transformed time series (stock returns) are stationary series. Since the series of returns fluctuate around zero, and do not exhibit any obvious trend, only a constant term in the regression line is included.

Table 4.2: Summary Statistics of Stock Returns: Daily Data 2/1/1995-26/7/2004

Countries	Average return	Std. Dev.	Kurtosis	Skewness	Jarque-Bera	p-value	Kolmogorov-Smirnov	p-value
UK	0,0138	1,1377	2,6910	-0,1669	760,36	0,00	2,90	0,00
Germany	0,0243	1,6097	2,7773	-0,2273	819,06	0,00	3,42	0,00
France	0,0256	1,4544	2,3806	-0,0814	588,62	0,00	2,52	0,00
Spain	0,0373	1,4185	2,4706	-0,1858	645,39	0,00	2,67	0,00
Italy	0,0248	1,4739	2,3188	-0,0736	588,03	0,00	2,39	0,00
Portugal	0,0331	0,9699	7,2617	-0,5656	5.591,6	0,00	4,59	0,00
Ireland	0,0419	1,0264	4,6553	-0,4962	2.344,9	0,00	3,74	0,00
Netherlands	0,0216	1,5107	3,7458	-0,0984	1.455,5	0,00	3,40	0,00
Belgium	0,0226	1,1553	5,1203	0,2528	2.739,7	0,00	3,90	0,00
Denmark	0,0404	1,1161	2,3545	-0,2780	605,17	0,00	3,18	0,00
Finland	0,0419	2,1714	5,8720	-0,4431	3.650,2	0,00	3,61	0,00
Austria	0,0259	1,0041	5,3185	-0,6942	3.127,6	0,00	3,19	0,00
Sweden	0,0341	1,5767	2,9592	0,1105	910,66	0,00	2,36	0,00
Greece	0,0397	1,6634	3,8996	-0,0478	1.574,2	0,00	4,07	0,00

The Augmented Dickey-Fuller (ADF) unit root test for the new series of first differences of the stock indexes performed by the E-views package are presented in Table 4.3.

Table 4.3: ***ADF Unit Root Test Results on Stock Returns for Each Stock Market***

Country	ADF Test Statistic	1% critical Value	5% critical value	10% critical value
UK	-49.73786	-2.5666	-1.9395	-1.6157
Germany	-50.96147	-2.5666	-1.9395	-1.6157
France	-49.43468	-2.5666	-1.9395	-1.6157
Spain	-48.37762	-2.5666	-1.9395	-1.6157
Italy	-50.33695	-2.5666	-1.9395	-1.6157
Portugal	-43.52468	-2.5666	-1.9395	-1.6157
Ireland	-45.53540	-2.5666	-1.9395	-1.6157
Netherlands	-49.35989	-2.5666	-1.9395	-1.6157
Belgium	-43.33697	-2.5666	-1.9395	-1.6157
Denmark	-47.56042	-2.5666	-1.9395	-1.6157

Finland	-49.42846	-2.5666	-1.9395	-1.6157
Austria	-47.96936	-2.5666	-1.9395	-1.6157
Sweden	-49.28503	-2.5666	-1.9395	-1.6157
Greece	-42.62519	-2.5666	-1.9395	-1.6157

The results of the ADF test statistic values are all less than the corresponding critical values, indicating that the null hypotheses of unit roots in the first differences of the stock prices (i.e. stock returns) are rejected at a 1% significance level, suggesting that the stock returns are stationary.

5. Stock Market Returns Correlations

As already noted, the establishment of EMU and the introduction of the euro directly removed a number of existing barriers between the European countries joining the EMU, and therefore, it is likely for one to expect that co-integration between the European countries from the specific time period and on is quite possible to increase. Examining the correlations between stock market returns provides an alternative to complex modeling methodology for checking evidence of integration, mainly due to its simplicity.

Table 5.4 presents simple Pearson's correlations for the period between 02/01/1995 and 26/07/2004 that is the correlations covering the sample period. The last two rows of Table 5.4 present average stock return correlations and the associated standard deviations. Accordingly, Tables 5.5 and 5.6 display Pearson's correlation coefficients for the two sub-periods that is the period before EMU (sample period 02/01/1995 - 31/12/1998) and the period after EMU (sample period 02/01/1999 - 26/07/2004), respectively. For the case of Greece the first period is 02/01/1995 – 31/12/2000 and the second 02/01/2001 – 26/07/2004.

A significant increase in the correlation coefficients of a country's stock returns between period 1 (before EMU) and period 2 (after EMU) would imply that the specific stock market has become more integrated contemporaneously in the second period. In Table 5.7 the comparisons of the average correlations of the two sub-periods are shown. Differences of the average correlations show that average correlations of returns have been increased in the period after the establishment of EMU in seven cases and have been decreased in seven. This is not a clear indication of a change in the degree of integration in the stock markets under consideration. Furthermore in order to verify if the average stock returns correlations differ statistically significantly between the two sub-periods (before and after EMU) the t-test for equality of means is utilized. The results of the 14 in total t-tests are reported in Table 5.8. The null hypothesis $H_0 : av1 - av2 = 0$ is tested against the alternative $H_0 : av1 - av2 \neq 0$. P-values of the tests indicate that differences in the average correlations between the two sub-periods are statistically significant, at a 5% significance level in six cases (p-value<0.05).

Based on this statistical result the conclusion is that three of the stock markets, France, Spain and Italy became more integrated in period 2 and three markets, Ireland, Denmark and Austria, became less integrated in the same period. For the remaining stock markets there is not clear indication of any change since the paired sample t-test has failed to support any change in the degree of integration.

Table 5.4: Correlations for the EU Member States (Returns, sample period 02/01/1995 - 26/07/2004)

	UK	*Germany*	*France*	*Spain*	*Italy*	*Portugal*	*Ireland*	*Netherlands*	*Belgium*	*Denmark*	*Finland*	*Austria*	*Sweden*	*Greece*
UK	1													
Germany	0,712	1												
France	0,795	0,787	1											
Spain	0,704	0,712	0,794	1										
Italy	0,688	0,688	0,770	0,743	1									
Portugal	0,503	0,536	0,568	0,606	0,526	1								
Ireland	0,572	0,514	0,533	0,481	0,473	0,419	1							
Netherlands	0,792	0,793	0,841	0,757	0,718	0,553	0,566	1						
Belgium	0,663	0,664	0,707	0,625	0,596	0,452	0,502	0,771	1					
Denmark	0,548	0,556	0,575	0,554	0,514	0,467	0,482	0,603	0,512	1				
Finland	0,582	0,585	0,627	0,580	0,536	0,493	0,461	0,627	0,450	0,506	1			
Austria	0,417	0,473	0,437	0,447	0,407	0,405	0,416	0,453	0,427	0,403	0,355	1		
Sweden	0,694	0,683	0,741	0,678	0,649	0,527	0,499	0,717	0,567	0,573	0,711	0,405	1	
Greece	0,253	0,261	0,256	0,269	0,234	0,267	0,266	0,290	0,258	0,261	0,258	0,206	0,254	1
Average	0,610	0,613	0,649	0,612	0,580	0,486	0,476	0,652	0,554	0,504	0,521	0,404	0,592	0,256
StDeviation	0,011	0,016	0,015	0,014	0,015	0,010	0,010	0,015	0,012	0,011	0,022	0,010	0,016	0,017

Table 5.5: Correlations for the EU Member States (Returns, sample period 02/01/1995 - 31/12/1998)

	UK	*Germany*	*France*	*Spain*	*Italy*	*Portugal*	*Ireland*	*Netherlands*	*Belgium*	*Denmark*	*Finland*	*Austria*	*Sweden*	*Greece**
UK	1													
Germany	0,647	1												
France	0,715	0,661	1											
Spain	0,642	0,633	0,703	1										
Italy	0,607	0,545	0,663	0,649	1									
Portugal	0,503	0,567	0,547	0,587	0,505	1								
Ireland	0,594	0,606	0,526	0,485	0,477	0,480	1							
Netherlands	0,732	0,743	0,712	0,677	0,609	0,589	0,585	1						
Belgium	0,659	0,684	0,663	0,616	0,568	0,547	0,546	0,742	1					
Denmark	0,581	0,646	0,540	0,567	0,529	0,515	0,531	0,632	0,558	1				
Finland	0,606	0,664	0,586	0,547	0,525	0,499	0,580	0,661	0,610	0,597	1			
Austria	0,529	0,677	0,536	0,536	0,477	0,516	0,559	0,588	0,562	0,521	0,549	1		
Sweden	0,685	0,642	0,686	0,627	0,585	0,513	0,535	0,698	0,625	0,560	0,711	0,505	1	
Greece	0,239	0,253	0,226	0,264	0,206	0,300	0,288	0,278	0,273	0,250	0,264	0,233	0,242	1
Average 1	0,595	0,613	0,597	0,579	0,534	0,513	0,522	0,634	0,589	0,541	0,569	0,522	0,614	0,255
StDeviation	0,009	0,013	0,012	0,013	0,015	0,010	0,009	0,012	0,009	0,010	0,015	0,011	0,013	0,016

*Period 02/01/1995-31/12/2000

Table 5.6: Correlations for the EU Member States (Returns, sample period 02/01/1999 – 26/07/2004)

	UK	*Germany*	*France*	*Spain*	*Italy*	*Portugal*	*Ireland*	*Netherlands*	*Belgium*	*Denmark*	*Finland*	*Austria*	*Sweden*	*Greece**
UK	1													
Germany	0,735	1												
France	0,828	0,839	1											
Spain	0,736	0,752	0,841	1										
Italy	0,751	0,785	0,848	0,811	1									
Portugal	0,515	0,530	0,588	0,620	0,541	1								
Ireland	0,564	0,475	0,535	0,477	0,475	0,384	1							
Netherlands	0,815	0,812	0,895	0,797	0,797	0,543	0,557	1						
Belgium	0,664	0,657	0,726	0,633	0,629	0,412	0,484	0,781	1					
Denmark	0,535	0,518	0,590	0,547	0,513	0,443	0,458	0,591	0,494	1				
Finland	0,577	0,562	0,647	0,604	0,570	0,513	0,425	0,619	0,402	0,480	1			
Austria	0,373	0,369	0,388	0,393	0,343	0,309	0,326	0,391	0,372	0,337	0,287	1		
Sweden	0,698	0,700	0,765	0,703	0,699	0,542	0,482	0,725	0,544	0,578	0,716	0,357	1	
Greece	0,263	0,268	0,274	0,271	0,253	0,240	0,253	0,299	0,253	0,267	0,263	0,187	0,263	1
Average 2	0,619	0,616	0,674	0,630	0,617	0,475	0,454	0,663	0,542	0,489	0,513	0,341	0,598	0,258
StDeviation	0,013	0,018	0,016	0,015	0,014	0,010	0,011	0,017	0,013	0,012	0,025	0,009	0,017	0,017

*Period 02/01/2001-26/07/2004

Table 5.7: Correlations Comparisons in the two Sub-Samples

Average 1	0,595	0,613	0,597	0,579	0,534	0,513	0,522	0,634	0,589	0,541	0,569	0,522	0,614	0,255
StDeviation	0,009	0,013	0,012	0,013	0,015	0,010	0,009	0,012	0,009	0,010	0,015	0,011	0,013	0,016
Variance	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Average 2	0,619	0,616	0,674	0,630	0,617	0,475	0,454	0,663	0,542	0,489	0,513	0,341	0,598	0,258
StDeviation	0,013	0,018	0,016	0,015	0,014	0,010	0,011	0,017	0,013	0,012	0,025	0,009	0,017	0,017
Variance	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,001	0,000	0,000	0,000
Dif. Av2-Av1	0,024	0,003	0,077	0,050	0,082	-0,038	-0,069	0,029	-0,046	-0,052	-0,056	-0,181	-0,016	0,003

paired sample t-test

Table 5.8: Hypothesis Testing about the Difference in the two Averages (Av1-Av2)

Av1-Av2	-0,024	-0,003	-0,077	-0,050	-0,082	0,038	0,069	-0,029	0,046	0,052	0,056	0,181	0,016	-0,003
StD Av1-Av2	0,081	0,147	0,090	0,082	0,103	0,076	0,069	0,105	0,089	0,065	0,104	0,065	0,071	0,034
t-test	-1,078	-0,062	-3,098	-2,198	-2,888	1,778	3,579	-0,993	1,878	2,881	1,950	10,016	-0,623	-0,315
p-value	0,302	0,952	0,009	0,048	0,014	0,101	0,004	0,341	0,085	0,014	0,075	0,000	0,545	0,759

(*) Av1-Av2 is statistically significant different from zero at a 5% significance level since p-value < 0.05

6. Conclusions

Apparently the establishment of the EMU and the introduction of the common currency do not have the same effects on the European stock markets. In three cases the stock market return correlations have increased and in other three have decreased. These results can be attributed to the EMU at least partially. The establishment of EMU was not the only reason for a change in the degree of integration in the European stock markets. The members of the EMU were at different points of readiness when the final decision had been taken. Before the EMU many countries in the EU were already taking part in other kind of integration initiatives (Taylor and Tonks, 1989). The German and the Austrian markets started an integration process through the DM before the euro while the Italian market, with a great weight of listed foreign companies, was already internationalized. All these unique characteristics of the stock markets make it impossible to clarify the effect of the EMU to all European stock markets (Yang, et al., 2003, Noia, 2001).

Other factors that have influenced the stock market return correlations during the recent years are the relaxation of controls on capital movements and foreign exchange transactions and generally the deregulation and market liberalization, major improvements in computer and communication technology that have lowered the cost of cross border information flows and financial transactions and the expansion in the multinational operations of major corporations (Bracker, et al., 1999, Chan,et al., 1997). These developments are clearly part of the globalization of the financial transactions and the higher synchronization of the stock markets while they are not clearly identified in an empirical study of this type.

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Assets Return and Risk and Exchange Rate Trends: An Ex Post Analysis

by
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Abstract ***

The objective of this analysis is to determine the movements (long-term trend) of the exchange rate by looking at the rate of return and risk that financial assets (3-month T-bills) have in four different economies, for four different investors. Risk averse speculators will try to maximize their return and minimize risk by investing in different countries, and these capital flows will affect the value of the four currencies (their exchange rates). The empirical results show that before 2001 the return in the U.S. was high and the dollar was appreciated; after 2001, the same return became negative and the dollar was depreciated, but after 2004 the returns have growing positively for the U.S. and relatively the same for the U.K.; the returns for the Euro-zone and Japan are falling. So, the dollar is expected to appreciate, the pound might experience a little appreciation and the euro will fall together with the yen. From this ex post analysis, we can conclude that, by forecasting risk and return in countries' assets, we can determine the long-term trend of these currencies (exchange rates) in the future.

Keywords: Estimation, Time-Series Models, Portfolio Choice, Forecasting and Other Model Applications, Foreign Exchange.

JEL Classification: C13, C22, C53, F31, G11.

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1. Introduction

In Europe, on January 4, 1999, the official launch for the single European currency ("euro") took place at the introductory rate of 1.1668 $/euro. Eleven European Union member states elect to participate in this new system; Greece joined the Euro group in 2001. Three years later, on January 1, 2002, euro coins and notes were introduced in the EU-12 (Euro-zone). The euro's value slid steadily following its introduction and reached the value of 0.8813 $/euro on December 31, 2001. Beginning in early 2002, the euro started a strong and steady rise in value, peaking at 1.3646 $/euro on December 30, 2004. After January 2005, the euro is slowly depreciated and became 1.2126 $/euro at the end of January 2006.[1] Today, it has become a popular reserve currency, representing 19.7% of central bank holdings.[2] Apart from issues of exchange rate risk and deeper capital markets, the euro has had bad record of success with regard the growth, the employment, the exports, the investments, the inflation, the loss of monetary policy for the EMU member-states, and its disapproval by the average European citizen.

In the U.S.A., years of large current account deficits, enormous national debt,[3] high real return on U.S. assets, and relatively low risk have left the United States with the world's largest stock of international liabilities. By the end of 2004, foreign net claims on the U.S. amounted to $2.5 trillion, equivalent to 22% of U.S. GDP.[4] This tremendous demand for U.S. assets was expected to appreciate the U.S. dollar relative to euro and the other foreign currencies, but data show exactly the opposite. Then, other factors might have affected the exchange rate between the dollar and the other major currencies, like speculation[5] and uncertainty for the future, due to the Middle East crises (Palestinians and Israelis, Afghanistan, Iraq, Israel's invasion in Lebanon, and the creeping ones in Iran, Syria, and North Korea). It is well established that the volatility of exchange rates[6] displays considerable persistence. That is, large movements in spot rates tend to be followed by more large movements later, which increasing risk and producing serial correlation in real returns. Thus, past and present volatility can be used to predict future volatility and the forward discount or premium of the different currencies. Investors in foreign assets must pay attention not only to the expected return from their investment activity, but also to the risk that they incur.[7] Risk averse investors try to reduce their exposure during periods of high volatility by predicting the return of their investment and the volatility (variance) of this return. This volatility has been forecasted with GARCH (p, q) models[8] or genetic programs,[9] which give broadly similar results. Investors will invest in assets denominated in a currency that its return

[1] See, Kallianiotis (2006b, Table 2).
[2] See, Eiteman, Stonehill, and Moffett (2007, p. 55).
[3] The outstanding national debt was $8.535 trillion on September 13, 2006 (www.brillig.com).
[4] See, Higgins, Klitgaard, and Tille (2005, p. 1).
[5] Speculators (actually, sordid gainers and profiteers) in the oil industry have cause uncertainty in the global economy, too. Some call them "white collar terrorists". Exxon Mobil Corp., the world's biggest oil company, said fourth-quarter profit rose 27% to a record $10.7 billion on surging energy prices, capping the most profitable year for any company in U.S. history. (Bloomberg.com, 1/30/2006 and *The Wall Street Journal*, January 31, 2005, pp. A1 and A3).
[6] Their standard deviations of their fd or fp are: $\sigma_{\$/euro} = \pm 30.00\%$, $\sigma_{\$/pound} = \pm 33.05\%$, $\sigma_{\$/yen} = \pm 27.27\%$, $\sigma_{pound/euro} = \pm 18.58\%$, $\sigma_{yen/euro} = \pm 30.94\%$, $\sigma_{pound/yen} = \pm 26.89\%$.
[7] Muslim countries avoid to invest in U.S. assets after 2003 (invasion in Iraq) because they are afraid that the American government might freeze their funds.
[8] See, Kallianiotis (2004a and b). Here, we use ex post analysis; we do not forecast any variables.
[9] See, Neely and Weller (2002).

will be higher than the others and its risk to be the smallest one. Determining these assets with the highest return and lowest risk, the trend of the exchange rate of this specific country can be determined. An excess demand for the country's assets will appreciate its currency.

Some recent facts ("news") reveal the effect of speculation on the different exchange rates. On Tuesday February 22, 2005, South Korea's Central Bank announced that plans to diversify its foreign exchange reserves, which traders took to mean a slowdown in purchases of dollar-denominated securities. The U.S. dollar fell to $1.3259 per euro and lost value with respect the other major currencies, too. The DJIA slid 174.02 points (1.6%) as concerns about the weak dollar sparked a sell-off of the U.S. currency. Also, Gold surged $7.40 to $434.50 and oil climbed to $51.42 per barrel.[10] In addition, terrorist attacks globally rose in 2004 to about 650 from 175 in 2003, said congressional aides briefed by State Department and intelligence officials.[11] A terrorist attack in London[12] on July 7, 2005 caused stocks worldwide to fall; the London stocks (FTSE 100 index) fell by 200 points, the DJIA fell by 250 points, U.K. pound slumped to $1.7403 from $1.7556, bonds gained (10-year AAA=4.80%), oil in N.Y. fell by $5 to $57, and gold price increased by $4 to $430 per troy ounce; but after this shudder in the markets, they rebounded quickly. On Monday, October 3, 2005, Turkey "invaded" EU and we were expected to see some effects on euro, but nothing happened; it did not change at all.[13] Then, invasions have no effect on exchange rates, only speculations do. Strange world and it is becoming worse every day! Economists and all social scientists will have a very hard time to analyze this fabricated anti-societal world. On November 1, 2005, the FOMC raised the federal funds rate to 4% and instead of having an appreciation of the U.S. dollar, we had the opposite the exchange rate increased to 1.2067 $/euro.[14] On December 13, 2005, Fed raised for 13th time in row the federal funds rate to 4.25% and instead of having an appreciation of the U.S. dollar, it fell to 1.2034 $/euro from 1.1668 $/euro that was on November 17, 2005.[15] At the same time, we read that the U.S. net purchases of overseas stocks during the first 10 months were on a pace to smash the 2003 record of $88.6 billion. At an average of more than $9.5 billion a month, the 2005 total could hit $115 billion.[16] This huge demand for foreign financial assets causes the dollar to depreciate. On February 16, 2006, it has fallen to 1.1877 $/euro.[17]

Although a number of economic models have been used to interpret exchange rate movements, virtually none of the existing models can explain exchange rate behavior well because it is so much speculation and uncertainty in this market that make economic theories useless. Some economists attempt to interpret the phenomenon of deviation of the actual currency values from their fundamental values as speculative bubbles. Particularly, economic agents form their exchange rate expectations based on a certain kind of extrapolative behavior.[18] Thus, favorable changes in financial variables or in the investment environment may tend to generate an exchange rate appreciation that, in turn, may lead to expectations of a further

[10] See, *The Wall Street Journal*, February 23, 2005, pp. A1, C1, C2, and C3; and "Dollar Declines as Bank of Korea Plans to Diversify Currency Reserves", Bloomberg.com, 2/22/2005.
[11] See, *The Wall Street Journal*, April 27, 2005, p. A1.
[12] A group purporting to be the terrorist organization al-Qaeda claimed responsibility for explosions during morning rush hour across London. The public transportation system was shutting down. (Bloomberg.com, July 7, 2005 and *The Wall Street Journal*, July 8, 2005, p. C1).
[13] See, *The Wall Street Journal*, October 4, 2005, pp. A1, A15, and A16.
[14] See, *The Wall Street Journal*, November 2, 2005, p. A1 and Bloomberg.com, 11/2/2005.
[15] See, Bloomberg.com, 12/14/2005.
[16] See, *The Wall Street Journal*, December 15, 2005, pp. A1, C1, and C14.
[17] See, Bloomberg.com, 2/16/2006.
[18] See, Tucker, Madura, and Chiang (1991, p. 52).

appreciation. But, here, especially with the "euro", there were no major changes in fundamentals. The above process continues as long as the market believes the currency price will persist moving in the same direction. Since the actual price moves farther away from the fundamentals as time passes, capital gains would have to be sufficiently large to compensate the risk of a bursting bubble, which it is not obvious for the euro at this moment.

Speculations and speculative bubbles have gained some empirical support in exchange rate determination literature. They were found in the DM/$ and FF/$ rates for the period June to October 1978. Evidence indicates that the German mark was overvalued with respect to its fundamental value by 12% and French franc by 11%.[19] A speculative bubble was also found in the United States, where the dollar appreciated substantially for the period 1980 through 1985. The same seems to be the case with the Euro-zone; the euro has been appreciated without any changes in the fundamentals (except the Iraqi war and the fear of another war in Iran) since the beginning of 2003, reached 1.3646 $/euro on December 30, 2004 and continues to be overvalued.[20] On October 6, 2005 it was 1.2129 $/euro[21] and on January 23, 2006, it was 1.2280 $/euro, which it is unjustifiable according to some researchers.[22] On April 24, 2006, the Secretary of the State (Condoleezza Rice) visited Greece and Turkey asking for their support towards Iran. The dollar devaluated drastically from 1.2307 $/euro to 1.2596 $/euro.[23] The latest U.S. threats towards Iran caused the dollar to fall to 1.2740 $/euro.[24] The Fed raised the Fed Funds rate to 5%, commercial banks raised their prime rate to 8%, the DJIA fell by -141.92 points to 11,500.73, and the Gold jumped to $724.50, its highest close price since September 1980, but the U.S. dollar depreciated to 1.2913 $/euro.[25] The Michigan index of consumer sentiment decreased to 79 in May 2006.[26] Why? The answer is: the global instability. The dollar was headed for its biggest weekly gain since November 2005 against the euro as Federal Reserve speakers suggested they will raise interest rates in June to keep inflation in check. Stock markets around the world plunged amid concern that rates are rising and growth is slowing.[27] Today, their exchange rate is 1.2691 $/euro and the prime rates are: $i_{US} = 8.25\%$, $i_{EU} = 3.00\%$, $i_{UK} = 4.75\%$, and $i_J = 1.625\%$.[28]

Meese and Rogoff (1983) conclude that exchange rate models do a poor job of tracking movements over short horizons. Then, the macroeconomic variables (money supply, income, interest rate, price level, debt, etc.) can explain changes in exchange rate over medium and long horizons. Currency traders, speculators, and other market participants who focus on the short-term horizon look beyond macroeconomic models. They, search for signs (like risk and return) of short-term changes in the demand for currencies (assets denominated in specific currency), using any available measures of market transactions, behavior, and news. It is important for

[19] See, Woo (1987).
[20] Euro was 0.8813 $/euro on December 31, 2001 and has been appreciated by 54.84% in three years. See, Kallianiotis (2005a and 2006b).
[21] Bloomberg.com (10/6/2005).
[22] Kallianiotis (2005b) is predicting an increase in the return on the U.S. T-Bills and an appreciation of the U.S. dollar, but here a new uncertainty appears for the world, the Iranian case.
[23] Bloomberg.com (4/20-28/2006).
[24] Bloomberg.com (5/5/2006) and *Wall Street Journal*, May 8, 2006, p. A1.
[25] Bloomberg.com (5/12/2006) and *Wall Street Journal*, May 11, 2006, p. A1.
[26] This index in April 2006 was 87.4. It is a drastic drop of consumers' confidence. See, Bloomberg.com (5/12/2006).
[27] The U.S. dollar advanced to 1.2636 $/euro. (*Bloomberg.com*, 6/9/2006 and *The Wall Street Journal*, June 9, 2006, p. A1).
[28] *The Wall Street Journal*, September 13, 2006, pp. A1 and C12.

economists to model short-term exchange rate dynamics and determine (forecast) the future value of the different currencies. Speculators in the futures market are constantly interpreting public and private information about ongoing shifts in foreign currency demand as they develop their directional views.[29]

We start, in section 2, with the development of the return domestically and in a foreign country by considering the exchange rate risk, and an investment choice. In section 3, some empirical results are given for the four economies. In section 4, policy implications are discussed for currencies, which deviate from their fundamentals. Lastly, we conclude with a few comments on this analysis.

2. Return, Exchange Rate Risk, and Investment Choice

This analysis includes an international portfolio balance theory and its implications for exchange rates. A starting point is the hypothesis that real money demand depends not only on income, the conventional transactions variable, but also on interest rate and on wealth, the speculative demand.[30] The internationalization of business and investment opportunities induce speculators to diversify their portfolios of assets denominated in a variety of currencies so that they can maximize their wealth (w_t) and minimize its risk (σ_w^2). Many times, we have experienced drastic effects on the value of currencies because these speculators decided to change overnight the content of their portfolios.[31]

These shifts in wealth induced by current account imbalances or portfolio diversification create monetary imbalances leading to adjustments in long-run price level expectations and thus to exchange rate movements. With perfect mobility of capital, these specifications of money demand imply that the real money demand of a country with a surplus or acquiring its assets rises while it falls abroad. The relative price level of the country with a surplus or with a high demand of its assets declines and, therefore, exchange rates for given terms of trade tend to appreciate.

The demand for monies is affected by an international redistribution of wealth. Portfolio effects can arise in the context of imperfect asset substitutability. With uncertain returns, portfolio diversification makes assets imperfect substitutes and gives rise to determinate demands for the respective securities and to yield differentials or a higher risk premium that one currency offers relative to the others.

A portfolio model could provide an explanation of the unanticipated euro appreciation that is only poorly accounted for by speculation, prominent return in Euro-zone market,[32] high

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[29] See, Klitgaard and Weir (2004).

[30] As follows: $\frac{M_t^d}{P_t} = \alpha_0 + \alpha_1 Y_t - \alpha_2 i_t + \alpha_3 w_t + \varepsilon_t$.

[31] In June 1997, the Asian currency crises started. The Thai baht devaluated in July, followed soon after by the Indonesian rupiah, Korean won, Malaysian ringgit, and Philippine peso. Following these initial exchange rate devaluations, Asian economies plummeted into recessions. The Indonesian president went public and blamed speculators (he named even one, George Soros) who shifted their short-term investments out of the country. Next day this poor president was forced to resign. See, Eiteman, Stonehill, and Moffett (2007, p. 44), Rajan and Zingales (1998), and Singal (1999).

[32] On September 20, 2006, at the meeting of the FOMC, the Fed left rates unchanged at 5.25% and the dollar fell with respect to euro, pound, and yen. The DJIA gained 72.28 points. (*The Wall Street Journal*, September 21, 2006, pp. A1, C1, and C2).

risk of holding U.S. dollar assets,[33] future uncertainty, and global instability. The system of flexible exchange, the macroeconomic policies, the disturbances lately,[34] and the new Iranian crisis have created an incentive for portfolio diversification, and that the euro will occupy a larger share in an efficiently diversified portfolio. The resulting portfolio shift or capital flows may account for some of the unanticipated appreciation of this new currency and not the EMU fundamentals.

We would like to measure the returns of four investors (American, European, Briton, and Japanese) on assets denominated in four different currencies (dollar, euro, pound, and yen). The nominal short-term interest rate for a foreign investor must be as follows (with ex post calculation), depending whether the currency is at a forward discount or at a forward premium:

$$i^*_{S-T_t} = i_{S-T_t} + fp^e_t \quad (1)$$

or $$i^*_{S-T_t} = i_{S-T_t} - fd^e_t \quad (2)$$

For a domestic investor, the same rate of interest is decomposed:

$$i_{S-T_t} = r_t + \pi_t \quad (3)$$

These equations can be expanded as,

$$i^*_{S-T_t} = i_{S-T_t} + (f_t - s_t) \quad (1')$$

or $$i^*_{S-T_t} = i_{S-T_t} - (f_t - s_t) \quad (2')$$

and $$i_{S-T_t} = r_t + (p_t - p_{t-1}) \quad (3')$$

By lagging interest rates and exchange rates one period (avoiding their forecasting), we have an ex post measure of the nominal rate of return of an asset,

$$i^*_{S-T_{t-1}} = i_{S-T\,t-1} + (s_t - s_{t-1}) \quad (4)$$

or $$i^*_{S-T_{t-1}} = i_{S-T\,t-1} - (s_t - s_{t-1}) \quad (5)$$

and $$i_{S-T_{t-1}} = r_{t-1} + (p_{t-1} - p_{t-2}) \quad (6)$$

where, i_{S-T}=the nominal short-term interest rate (return), r= the real rate of interest, □=the inflation rate, fd=the forward discount of the currency, fp=the forward premium, p=the ln of

[33] Some "news" were: "Syrians' funds will freeze in the U.S. banks". (TV News, March 6, 2005). "Dollar declined as Bank of Korea plans to diversify currency reserves." (Bloomberg.com, February 22, 2005).

[34] The U.S. Treasury reported the federal deficit hit a monthly record of $113.94 billion in February of 2005. Greenspan told the Council on Foreign Relations deficits pose a bigger risk to the U.S. than trade imbalances or low savings. (*The Wall Street Journal*, March 11, 2005, p. A1).

price index, s=the ln of spot exchange rate, f=the ln of forward exchange rate, "^{e}" the expected value of the variable, and an asterisk denotes the foreign country.

Now, we take the utility function of an investor who wants to maximize his end-of-period real wealth (w) by investing on home (i_{US}^{A}, i_{EU}^{E}, i_{UK}^{B}, i_{J}^{J})[35] and foreign ($i_{US}^{I^*}$, $i_{EU}^{I^*}$, $i_{UK}^{I^*}$, $i_{J}^{I^*}$)[36] securities and to determine the optimal portfolio share of domestic and foreign securities (x_{US}^{I}, x_{EU}^{I}, x_{UK}^{I}, x_{J}^{I}).

$$\text{Max } U = u(\overline{w}, \sigma_{\overline{w}}^{2}) \tag{7}$$

where, U=the utility function, $\overline{w}$=the mean of the end-of-period random wealth, and $\sigma_{\overline{w}}^{2}$=the variance of wealth, x=the optimal portfolio share (weights) on domestic and foreign securities (denominated in different foreign currencies), and I=investors (A, E, B, and J) investing in each one of these four countries (j=U.S., Euro-zone, Britain, and Japan).

The solution of eq. (7) will be to construct four different portfolio of four different assets (i_{US}^{I}, i_{EU}^{I}, i_{UK}^{I}, i_{J}^{I}) for four different investors (I: A=American, E=European, B=Briton, and J=Japanese), which will maximize their returns, $E(R_P)$, and minimize their risks, $\sigma_{R_p}^{2}$. Also, the calculation of the return to variability ratios (RVR) of these sixteen (4x4) investment opportunities can be measured, eq. (8), and invest in countries where the RVR is maximized. If investors would choose to invest in country j, due to high return and low risk, the high demand for this country's assets would increase the demand for its currency and the currency will appreciate.

$$\text{Max} \quad RVR = \frac{i_j^I}{\sigma_{i_j^I}} \tag{8}$$

where, RVR=return to variability ratio, i_j^I=nominal return of asset j (in U.S., EU, U.K., and Japan) for investor I (American, European, Briton, and Japanese), and $\sigma_{i_j^I}$=the standard deviation of the nominal return of asset j for investor I.

The first step in evaluating the strength of any relationship between rate of return and exchange rates is to look for visual evidence. Plotting the levels of the rate of return against exchange rate levels reveals no obvious patterns. However, a fairly clear relationship emerges when looking at changes in the two variables. Knowing the change of the rate of return of a country would have allowed someone to guess correctly only the L-T direction of the U.S. dollar, the euro, the pound, and the yen. Tests show that movements of rate of return and its risk in one country anticipate how speculators change their demand and supply of assets denominated in this specific currency. The nature of exchange rate dynamics could argue about the contemporaneous relationship between return/risk and exchange rates and their future trends.

Furthermore, currency market participants are heterogeneous and act on their own bits of private information, as well as on public information.[37] Examples of private information include participants' expectations of future economic variables, perceptions of public policy, perceptions

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[35] The variables i_j^I can be calculated by using eqs. (3') and (6).

[36] The variables $i_j^{I^*}$ are calculated from eqs. (4) and (5).

[37] See, Evans and Lyons (2002).

of official and private sector demand, and perceptions of developing shifts in global liquidity and risk taking. Speculators act immediately in advance of exchange rate movements in a way that anticipates the direction of exchange rates and the rate of return.

Our objective is to seek data to help us understand what is driving the exchange rate at any given time. Variables that are viewed as fundamental to dictating currency values (relative money supply, output, inflation rates, interest rate differentials, etc.) are constantly analyzed and forecast. Various transaction data are also examined to determine demand changes in different currencies. The results suggest that expected rate of return and risk in different countries merit inclusion in policy analysis and in ongoing research on exchange rate trend, its dynamics, and its determination. A long-term trend of the interest rate (i_j^I) can be derived by using the Hodrick-Prescott (HP) filter[38] (smoothed series, jII), which is presented in eq. (9) below. Then, the exchange rate trend will follow the L-T trend of the rate of return.

The HP filter chooses jII to minimize:

$$\sum_{t=1}^{T}(i_{j_t}^{I} - jII_t)^2 + \lambda\sum_{t=2}^{T-1}[(jII_{t+1} - jII_t) - (jII_t - jII_{t-1})]^2 \qquad (9)$$

The penalty parameter λ controls the smoothness of the series jII. The larger the λ, the smoother the jII. As $\lambda \to \infty$, jII approaches a linear trend. And jII (j country's return for an investor from country I) = USIA, USIE, USIB, USIJ; EUIE, etc.

3. Empirical Results

So far, we have discussed the theoretical part of the rate of return and the risk of an asset denominated in different currencies. The current ex post analysis will measure the rate of return of a portfolio of four assets (U.S. T-bills, EU, U.K., and Japanese ones) in four currencies (dollar, euro, pound, and yen) and four investors (American, European, Briton, and Japanese) by considering the risk of the individual assets return, due to unanticipated exchange rate movements and other socio-economic fundamentals. The data, taken from economagic.com and imfstatistics.org, are monthly from 1999:01 to 2005:12. They comprise spot exchange rate, money supply (M2), consumer price index (CPI), federal funds rate, 3-month T-bill rate, prime rate, government bonds rate, real GDP, real risk-free rate of interest, risk premium (i_{GB}-i_{3MTB}), current account, unemployment rate, budget deficit, national debt, personal saving rate, price of gold, price of oil, and stock market index (DJIA) for these four countries.

Table 1 presents the six exchange rates [USEUS ($/euro), USUKS ($/pound), USJS ($/yen), UKEUS (pound/euro), JEUS (yen/euro), and UKJS (pound/yen)]. The sample is divided into two sub-periods, from 1999:01-2001:12 (before the introduction of the euro-notes) and from 2002:01-2005:12 (after the circulation of the euro-notes). Also, the sixteen rate of returns are calculated by taking into consideration the forward discount (fd) or premium (fp) of the currencies. The return for an American investor investing in EU was -3.76% and for a European investing in U.S. was 13.67%. The highest return was in the U.S., followed by U.K., Japan, and lastly the Euro-zone. During this period the dollar was at a premium; the pound at a discount with respect the dollar and the yen, and at a premium toward the euro; the euro was at a discount towards all the other currencies; the Japanese yen was at a discount with respect the dollar and at

[38] See, Hodrick-Prescott (1997).

a premium with respect the euro and pound. After 2002, the highest return was in Euro-zone, following by U.K. and Japan. The worst return was in the U.S. (-6.12% for a European investing in the U.S.). The dollar was at a discount with respect all the other currencies; it was followed by the yen and the pound. The euro was at a premium with all the currencies.

Table 2 supplies a Granger causality test between the macro-variables (fundamentals) and the exchange rates. Between 1999 and 2001, the variables that caused changes in exchange rate in the U.S. were, inflation, real income growth, and real risk free rate of interest. In the EU, there were no variables causing the $/euro or the pound/euro exchange rates, only the yen/euro rate was caused by money growth, overnight rate, lending rate, risk premium, and unemployment. In the U.K., the T-bill rate and the risk premium were causing the $/pound rate; and the money growth and the current account were causing the pound/yen rate, but no variable was causing the pound/euro rate. In Japan, the risk premium and the current account were causing the $/yen rate; the risk premium, the current account, and the government bond were causing the yen/euro rate; the money supply, the risk free rate of interest, the government bond rate, the risk premium, and the current account are causing the pound/yen exchange rate. After 2002, in the U.S. there was no variable causing the $/euro exchange rate; it was the personal saving rate and the price of gold, which caused the $/pound rate; and the price of gold that caused the $/yen rate. In EU, no variable had caused the $/euro and the pound/euro exchange rates; only the lending rate caused the yen/euro rate. In the U.K., the T-bill, the government bond rate, the risk premium, and the price of gold caused the $/pound rate; also, the risk premium caused the pound/euro rate, but there was no variable to cause the pound/yen rate. In Japan, it was only the real GDP growth that caused the $/yen exchange rate and nothing else shown any causality for yen/euro or pound/yen exchange rates.

Table 3a gives the average return, standard deviation (risk) of the return, and the return to variability ratio. The highest return for this period was for $i_{UK}^{J} = 5.953\%$ and the lowest for $i_{J}^{B} = 0.515\%$. The lowest risk is for a Japanese investor investing in Japanese T-bills ($\sigma_{i_J^J} = \pm 0.159$), the highest risk was for the European investor investing in Japan ($\sigma_{i_J^E} = \pm 31.701$). The return to variability ratio ranks, first $i_{J}^{J} = 11.969$, second $i_{UK}^{B} = 6.095$, third $i_{US}^{A} = 1.731$, and lastly $i_{EU}^{E} = 1.692$.

Table 3b presents the returns, risk, and the return to variability ratios from 1999:01 to 2001:12. The highest return during this period was in the U.S. by a European investor ($i_{US}^{E} = 13.683\%$) and the lowest in the EU for an American investor ($i_{EU}^{A} = -3.764\%$). The risk was smaller in Japan for a Japanese investor ($\sigma_{i_J^J} = 0.093$) and worst in Japan for a European investor ($\sigma_{i_J^E} = 41.000$). The return to variability ratio ranks first Japan for investors (22.151%), second U.K. for Briton investors (8.995%), third U.S. for American investors, and lastly EU for European investors. The best country for foreign investors is the U.S., it is followed by U.K., Japan, and lastly the Euro-zone. This might be the reason that the U.S. dollar was appreciated during that period and the euro was losing value.

Table 3c reveals the return, risk, and return to variability ratio for these investments from 2002:01 to 2005:12. During this period, the highest ratio was for Japanese investors investing in Japan. It follows by Britons investing in the U.K., then Europeans investing in the Euro-zone, and the worst Americans investing in the U.S. For foreigners, the highest return to variability ratios were in EU, following by the U.K., Japan, and the worst in the U.S. Then, the low return in the U.S. for Americans and the negative ones for Europeans, Britons, and Japanese made the

U.S. assets the least attractive and the U.S. dollar declined, due to its low demand by domestic and foreign investors.

Lastly, we did a smooth estimate of the long-term trend of the rate of return in the four different countries by using the Hodrick-Prescott Filter of eq. (9). The results are presented graphically in Figure 1. The first graph shows that the trend for the U.S. assets is positive and increasing. Then, investors will invest in the U.S. and the dollar will appreciate. The second graph points that the trend for foreign investors in EU is becoming negative and the euro will depreciate. The third one gives positive trend for Europeans, Japanese, and Britons investing in U.K. assets, but negative for Americans investing there. Then, the results for the pound are mixed. The last graph displays flat slopes for Europeans, Britons, and Japanese investing in Japan and negative slopes for Americans investing in that country. Then, the Japanese yen is not expected to appreciate.

Since the introduction of the euro, the correlation coefficients are very high for the following rates: $\rho_{\$/euro,\$/pound} = +0.972$, $\rho_{pound/euro,\,yen/euro} = +0.911$, and $\rho_{pound/yen,\,yen/euro} = -0.949$. On the other hand, the correlation coefficients are very small for the following exchange rates: $\rho_{pound/euro,\$/yen} = +0.248$, $\rho_{yen/euro,\$/yen} = +0.052$, and $\rho_{\$/yen,\,pound/yen} = +0.146$. Then, when the U.S. dollar is depreciated, the euro and pound are appreciated; and when the euro is appreciated, the pound and yen are depreciated. Lastly, when the yen is appreciated, the pound and the euro are depreciated.

4. Policy Implications of Currencies deviated from their Fundamentals

Even though that the U.S. dollar has depreciated drastically since 2001 (i.e., -52.66% with respect to euro),[39] the current account deficits have assumed extraordinary proportions.[40] A current account deficit is matched by a capital account surplus. In other words, a country with a current account deficit surrenders claims on future income (physical assets, stocks, and bonds) to foreigners. The ongoing U.S. current account deficit translates into an average of billions dollars in net capital imports per business day. That is, foreign investors have been accumulating U.S. assets at an unusually high rate. Foreign investors might become wary of holding increasingly larger portions of their wealth in U.S. assets. In order to promote continued investment in the United States, U.S. assets would then have to become more attractive. One way of attracting foreign investments is to lower the price of the asset in foreign currency terms. A decline in the foreign exchange value (depreciation) of the dollar would do just that. Therefore, a large current account deficit might be expected to depress the value of the dollar over time.

A reasonable question arises now; but, what about the persistent current account deficit? Indispensably, trade policies must improve it and citizens must make their demands for imports more elastic $(|\varepsilon_M| > 1)$ for their own good (personal interest) and their country's benefits. The following identity holds for an economy,

$$Y - E = T - G + S - I = X - M \tag{10}$$

[39] See, Kallianiotis (2006b, Table 2).

[40] Trade deficit in U.S. widened to a record in 2005 reaching $726 billion, even though that the U.S. dollar was depreciated. (Bloomberg.com, 2/10/2006). In 2006, from January to July, the trade deficit was $453 billion, $55 billion more comparing with the same period in 2005. (Cencus.gov, 9/22/2006).

where, Y=income (GDP), E=expenditures, T=taxes, G=government spending, S=saving, I=investment, X=exports, and M=imports.

If (X-M<0) in the above eq. (10), a devaluation might improve this current account deficit. But, a necessary and sufficient condition (Marshall-Lerner) must hold,

$$|\varepsilon_M| + |\varepsilon_{M^*}| > 1 \tag{11}$$

where, ε_M =the domestic price elasticity of the demand for imports and ε_{M^*} =the foreign price elasticity of demand for their imports.

Then, the process could be as follows (if Marshall-Lerner condition holds):

$$CAD \uparrow \Rightarrow (KAS) \uparrow \Rightarrow EX\ S_{assets} \Rightarrow P_{assets} \downarrow and\ (i_{assets} \uparrow) \Rightarrow to\ promote\ sales\ (S) \uparrow (\$ \downarrow) \Rightarrow CAD \downarrow$$

where, CAD=current account deficit and KAS=capital account surplus.

The current account and capital account are two sides of the same coin. A country that is running a current account deficit $(M_{Goods} > X_{Goods})$ is necessarily also running a capital account surplus $(X_{Financial\ Assets} > M_{Financial\ Assets})$. Foreign-owned assets in the United States increased from less than $2.5 trillion in 1990 to over $10 trillion by the end of 2003. Today, they must be in the area of $12 trillion, due to widened trade deficits.[41] Over the same period, U.S.-owned assets abroad increased from $2.3 trillion to nearly $7.9 trillion.[42]

Even though that the return was lower in the U.S., investors invest here, because of the unparalleled efficiency, stability, transparency, certainty, and liquidity of the U.S. financial markets. Investors find that dollar-denominated claims are an attractive element of any international portfolio. This process of investors seeking the most beneficial combination of risk and return, rebalancing portfolio when opportunities arise, gives rise to a source of capital account dynamics that is unrelated in any direct way to the pattern of trade in goods and services. Figure 1 shows a smoothing of the series (the four returns in U.S., in Euro-zone, in U.K., and Japan that domestic and foreign investors face) by using the Hodrick-Prescott (1997) filter to obtain a smooth estimate of the long-term components of the series (i_j^I's). The graphs reveal that the L-T returns are increasing for all investors investing in the U.S. financial assets. Then, this excess demand for U.S. assets, due to high returns and the tremendous current account deficit in the U.S. will appreciate the U.S. dollar, relative to the other three currencies.[43]

5. Concluding Remarks

The objective of this ex post analysis is to determine the exchange rates (their L-T trend) for four different countries (U.S., Euro-zone, England, and Japan). Since 2003:01, the U.S. dollar is losing value with respect the euro and other major currencies of the world and we want to see

[41] See, www.bloomberg.com, 2/10/2006.

[42] See, Pakko (2004).

[43] The recent exchange rate confirms these predictions; the spot rate fell to S = 1.1877 $/euro on February 16, 2006. (Bloomberg.com, 2/16/2006). But, the Israeli invasion in Lebanon (Summer 2006) with its tremendous destruction of that country and the thousands of war refugees imposed on Cyprus, a plan since 1902, according to historians, and the current Iranian crisis changed the predicted results, due to this growing global instability.

if this depreciation depends on economic fundamentals (lower return in the U.S. and higher risk and on the other macroeconomic variables) or it is just speculation from individuals and countries, which hold large amounts of foreign assets denominated in different currencies or due to the current global instability. The preliminary conclusion from this ex post analysis is, here, that, international investors are investing in countries with higher return and lower risk (exchange rate risk and political risk). This increase in demand for these assets increases the demand for currency in that country and its currency is appreciated. Before 2001, people were invested in the U.S. and Japan, so the U.S. dollar and the Japanese yen were appreciated. After 2001, they invested in Euro-zone and the U.K. and the dollar and yen lost their value. The exchange rate data confirm this relationship between the smooth estimates of the rate of return and currency values. Of course, due to high risk (wars and creeping ones and political conflicts) and low returns many speculators have invested in euros and other currencies, instead in dollars denominated assets. Historically, the American government has frozen the foreign assets inside the U.S. when a conflict arises. The L-T smoothing of these returns shows that they are growing in the U.S and in England, and are declining for Americans investing in the other three countries and for other international investors, so the demand for U.S. investment will increase and the U.S. dollar is expected to appreciate in the future. Investors know what is going on globally and act accordingly, so speculators take advantage of this knowledge. Already, the current data show this trend; the dollar from S = 1.3646 $/euro (12/30/2004) had reached S = 1.1877 $/euro (2/16/2006).[44] Now, with the new Iranian crisis (global instability) the dollar started losing value.

Finally, by constructing a portfolio of different assets, we can maximize the utility function of a speculator by maximizing his return and minimizing his risk. From these returns and risk or the return to variability ratio (RVR), we can conclude if the currency will appreciate or not. High expected return on assets denominated in dollar means that dollar is expected to appreciate. The empirical results are supporting this argument before the 2001 and after. But, the preliminary tests show that economic fundamentals have less effect on exchange rates, lately; then, exchange rates depend mostly on speculation, due to the expected risk (uncertainty) and return. The paper needs some more data and an ex ante analysis (forecasting) of the returns and risks for all the major countries involved in the global trade (or an exchange rate index of the dollar with respect the major currencies) and more statistical and portfolio analysis to give better results for the future trends of the currencies, especially the two major ones, euro and dollar.

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[44] See, bloomberg.com.

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Table 1
Spot Exchange Rates, Rates of Return, Natural Logarithms, and Forward Discounts or Premiums

	(1999:01-2005:12)						(1999:01-2001:12)						(2002:01-2005:12)					
	$\bar{S}$	σ_S	$\bar{s}$	σ_s	fd (+)	σ_{fd}	$\bar{S}$	σ_S	$\bar{s}$	σ_s	fp (-)	σ_{fp}	$\bar{S}$	σ_S	$\bar{s}$	σ_s	fd (+)	σ_{fd}
USEUS	1.069	0.15	0.06	0.14	0.52	30.00	0.956	0.08	-0.05	0.08	-9.01	30.34	1.146	0.13	0.13	0.12	7.06	28.22
USUKS	1.628	0.15	0.48	0.09	0.78	22.05	1.521	0.08	0.42	0.05	-4.63	19.70	1.701	0.14	0.53	0.09	4.49	22.98
USJS	0.009	0.01	-4.74	0.07	-0.48	27.27	0.009	0.01	-4.74	0.06	-4.08	30.47	0.009	0.01	-4.74	0.07	1.98	24.86
UKEUS	0.654	0.03	-0.43	0.05	-0.26	18.58	0.628	0.02	-0.47	0.04	-4.38	20.90	0.672	0.03	-0.40	0.04	2.57	16.43
JEUS	122.05	13.99	4.80	0.12	1.00	30.94	109.28	10.55	4.69	0.09	-4.94	40.99	130.82	8.04	4.87	0.06	5.07	21.05
UKJS	0.005	0.01	-5.22	0.07	-1.26	26.89	0.006	0.01	-5.16	0.06	0.56	33.89	0.005	0.01	-5.27	0.03	-2.51	21.09

	(1999:01-2005:12)				(1999:01-2001:12)				(2002:01-2005:12)			
	$\bar{i}_j^I$	$\sigma_{i_j^I}$	$f\bar{d}$ or $f\bar{p}$	$\sigma_{fd\ or\ fp}$	$\bar{i}_j^I$	$\sigma_{i_j^I}$	$f\bar{d}$ or $f\bar{p}$	$\sigma_{fd\ or\ fp}$	$\bar{i}_j^I$	$\sigma_{i_j^I}$	$f\bar{d}$ or $f\bar{p}$	$\sigma_{fd\ or\ fp}$
i_{US}^A	3.05	1.76			4.67	1.23			1.69	0.80		
i_{US}^E	2.53	30.59	0.52	30.00	13.67	30.50	-9.01	30.34	-6.12	29.21	7.81	28.99
i_{US}^B	2.27	22.64	0.78	22.05	9.30	19.95	-4.63	19.70	-3.59	23.91	5.29	23.68
i_{US}^j	3.53	27.56	-0.48	27.27	8.75	30.39	-4.08	30.47	-1.05	25.09	2.74	24.86
i_{EU}^E	3.37	1.99			5.25	1.40			1.94	0.87		
i_{EU}^A	3.91	30.00	-0.52	30.00	-3.76	30.24	9.01	30.34	9.75	28.77	-7.81	28.99
i_{EU}^B	2.91	18.85	0.26	18.58	0.87	20.98	4.38	20.90	4.46	17.12	-2.52	17.17
i_{EU}^J	4.12	31.51	-1.00	30.94	0.31	40.80	4.94	40.99	7.01	22.09	-5.07	22.11
i_{UK}^B	4.57	0.75			5.20	0.58			4.09	0.46		
i_{UK}^A	5.30	22.26	-0.78	22.05	0.57	19.59	4.63	19.70	9.37	23.61	-5.29	23.68
i_{UK}^E	5.05	19.08	-0.26	18.58	9.58	20.89	-4.38	20.90	1.56	17.23	2.52	17.17
i_{UK}^J	5.95	27.39	-1.26	26.89	4.64	33.83	0.56	33.89	6.63	21.89	-2.55	21.88
i_J^J	1.90	0.16			2.06	0.09			1.79	0.07		
i_J^A	1.25	27.58	0.48	27.27	-2.02	30.47	4.08	30.47	4.53	24.88	-2.74	24.86
i_J^E	1.00	31.70	1.00	30.94	7.00	41.00	-4.94	40.99	-3.28	22.10	5.07	22.11
i_J^B	0.52	27.45	1.26	26.89	2.62	33.89	-0.56	33.89	-0.76	21.88	2.55	21.88

Note: See, Table 2.
Source: Economic Time Series Page by Eveline Tainer at http://www.economagic.com and hhtp://www.imfstatistics.org.

Table 2
Pairwise Granger Causality Tests (1999:01-2001:12)

$X \Rightarrow \dot{S}$	$\dot{m}$	π	i_{FF}	i_{RF}	i_P	i_{GB}	$\dot{q}$	r^*	RP	LCA	u	LND	psr	L P_{Gold}	L P_{oil}	LDJIA
U.S.																
$\dot{S}$ ($/euro)	0.207	3.460**	0.243	0.093	0.529	0.260	1.364	3.313**	0.033	0.610	0.824	1.659	0.403	2.135	0.113	0.506
$\dot{S}$ ($/pound)	0.601	3.356**	0.832	0.540	1.382	0.026	2.223	2.404	0.596	0.297	0.475	1.704	0.199	1.524	0.820	0.345
$\dot{S}$ ($/yen)	1.784	0.006	1.913	1.861	1.408	0.971	4.764**	0.023	0.815	0.602	0.400	0.812	0.435	0.686	2.185	0.293
EU																
$\dot{S}$ ($/euro)	0.097	2.057	0.314	0.538	0.868	0.101	0.963	0.894	0.334	0.627	0.728	-	-	2.135	0.113	-
$\dot{S}$ (pound/euro)	0.623	1.619	0.926	0.173	1.070	0.107	0.335	1.536	0.644	1.182	1.507	-	-	1.091	1.194	-
$\dot{S}$ (yen/euro)	2.973*	1.140	2.911*	0.516	4.285**	1.248	1.990	1.048	2.993*	0.390	3.652**	-	-	0.256	0.869	-
U.K.																
$\dot{S}$ ($/pound)	0.901	0.782	-	2.569*	-	2.481	1.086	0.530	6.073***	0.279	0.332	-	-	1.524	0.820	-
$\dot{S}$ (pound/euro)	1.179	2.382	-	0.228	-	0.120	1.196	2.353	0.048	0.062	1.925	-	-	1.091	1.194	-
$\dot{S}$ (pound/yen)	2.864*	0.129	-	0.343	-	1.319	1.344	0.154	0.049	4.080**	2.419	-	-	0.004	0.923	-
J																
$\dot{S}$ ($/yen)	1.138	0.491	-	1.504	-	1.914	1.422	0.507	3.099*	3.131*	0.916	-	-	-	-	-
$\dot{S}$ (yen/euro)	2.230	0.961	-	2.076	-	3.251*	1.380	1.018	5.610***	8.011***	0.688	-	-	-	-	-
$\dot{S}$ (pound/yen)	4.121**	0.988	-	2.650*	-	5.978***	1.562	1.062	8.883***	8.301***	0.040	-	-	-	-	-

Table 2 (continued)

Pairwise Granger Causality Tests (2002:01-2005:12)

$X \Rightarrow \dot{S}$	$\dot{m}$	π	i_{FF}	i_{RF}	i_P	i_{GB}	$\dot{q}$	r^*	RP	LCA	u	LND	psr	L P_{Gold}	L P_{oil}	LDJIA
U.S.																
$\dot{S}$ ($/euro)	0.133	0.545	0.483	1.576	0.486	1.098	0.003	0.472	1.403	0.017	1.377	1.165	0.481	1.682	0.466	1.061
$\dot{S}$ ($/pound)	0.431	0.700	0.527	2.392	0.516	1.446	0.591	0.523	2.045	0.557	0.630	0.621	2.651*	3.700**	0.535	0.138
$\dot{S}$ ($/yen)	0.510	0.287	0.451	1.990	0.511	1.366	0.790	0.340	1.148	0.262	1.646	0.160	0.936	2.937*	0.205	0.076
EU																
$\dot{S}$ ($/euro)	0.126	0.016	0.492	0.817	0.211	1.439	0.793	0.179	0.579	0.231	0.398	-	-	0.843	0.467	-
$\dot{S}$ (pound/euro)	0.121	1.318	0.860	0.087	0.068	1.133	0.692	1.632	1.007	0.936	0.314	-	-	0.440	0.487	-
$\dot{S}$ (yen/euro)	1.090	1.008	1.153	0.414	2.731*	0.541	1.290	0.979	0.715	0.965	1.311	-	-	0.798	0.560	-
U.K.																
$\dot{S}$ ($/pound)	2.061	0.392	-	2.514*	-	3.621**	1.182	0.616	3.644**	2.288	0.612	-	-	3.700**	0.535	-
$\dot{S}$ (pound/euro)	0.059	1.510	-	0.427	-	1.616	1.752	1.562	2.440*	0.948	0.579	-	-	0.440	0.487	-
$\dot{S}$ (pound/yen)	1.778	0.764	-	0.894	-	0.035	0.500	0.764	0.321	0.292	0.164	-	-	0.070	0.357	-
J																
$\dot{S}$ ($/yen)	0.075	0.665	-	0.321	-	0.112	2.984*	0.664	0.110	2.201	0.605	-	-	-	-	-
$\dot{S}$ (yen/euro)	0.389	0.161	-	0.158	-	2.143	0.467	0.161	2.123	0.141	1.297	-	-	-	-	-
$\dot{S}$ (pound/yen)	0.096	0.002	-	0.007	-	1.028	0.953	0.002	1.029	0.350	0.046	-	-	-	-	-

Note: USEUS=dollar/euro spot exchange rate ($/euro), USUKS=dollar/pound spot ($/pound), USJS=dollar/yen spot ($/yen), UKEUS=pound/euro spot (pound/euro), JEUS=yen/euro spot rate (yen/euro), UKJS=pound/yen spot exchange rate (pound/yen), $\overline{S}$ =the mean spot rate, $\bar{s}$ =the mean of the ln S, σ_S =the standard deviation, fd=the forward discount, fp=the forward premium, i_{US}^{A} =US interest rate for an American, i_{US}^{E} =US interest rate for a European, i_{US}^{B} =US interest rate for a Briton, i_{US}^{J} =US interest for a Japanese, i_{EU}^{E} =EU interest for a European, i_{EU}^{A} =EU interest for an American, i_{EU}^{B} =EU interest for a Briton, i_{EU}^{J} =EU interest for a Japanese, i_{UK}^{B} =UK interest for a Briton, i_{UK}^{A} =UK interest for an American, i_{UK}^{E} =UK interest for a European, i_{UK}^{J} =UK interest for a Japanese, i_{J}^{J} =Japanese interest for a Japanese investor, i_{J}^{A} =Japanese interest for an American, i_{J}^{E} =Japanese interest for a European, and i_{J}^{B} =Japanese for a Briton; $X \Rightarrow \dot{S}$ = X causes $\dot{S}$, $\dot{S}$ =the growth of the spot exchange rate, Numbers are F-Statistics, *** =significant at the 1% level, **= significant at the 5% level, and *= significant at the 10% level.

Source: See, Table 1.

Table 3a
Investments in U.S., Euro-zone, U.K., and Japanese Assets:
Return, Risk, and Return to Variability Ratio (1999:01-2005:12)

	i_{US}^{A}	i_{US}^{E}	i_{US}^{B}	i_{US}^{J}	i_{EU}^{E}	i_{EU}^{A}	i_{EU}^{B}	i_{EU}^{J}	i_{UK}^{B}	i_{UK}^{A}	i_{UK}^{E}	i_{UK}^{J}	i_{J}^{J}	i_{J}^{A}	i_{J}^{E}	i_{J}^{B}
$\bar{x}$	3.050	2.534	2.274	3.533	3.371	3.912	2.911	4.117	4.565	5.301	5.053	5.953	1.903	1.251	1.004	0.515
σ_x	1.762	30.591	22.638	27.563	1.992	29.997	18.848	31.513	0.749	22.264	19.076	27.388	0.159	27.584	31.701	27.454
$\frac{i_x}{\sigma_x}$	1.731	0.083	0.100	0.128	1.692	0.130	0.154	0.131	6.095	0.238	0.265	0.217	11.969	0.045	0.032	0.019

Table 3b
Investments in U.S., Euro-zone, U.K., and Japanese Assets:
Return, Risk, and Return to Variability Ratio (1999:01-2001:12)

	i_{US}^{A}	i_{US}^{E}	i_{US}^{B}	i_{US}^{J}	i_{EU}^{E}	i_{EU}^{A}	i_{EU}^{B}	i_{EU}^{J}	i_{UK}^{B}	i_{UK}^{A}	i_{UK}^{E}	i_{UK}^{J}	i_{J}^{J}	i_{J}^{A}	i_{J}^{E}	i_{J}^{B}
$\bar{x}$	4.672	13.683	9.304	8.748	5.248	-3.764	0.869	0.312	5.199	0.567	9.578	4.642	2.060	-2.015	6.996	2.617
σ_x	1.231	30.495	19.947	30.385	1.398	30.244	20.982	40.801	0.578	19.593	20.892	33.829	0.093	30.475	41.000	33.893
$\frac{i_x}{\sigma_x}$	3.795	0.449	0.466	0.288	3.754	-0.124	0.041	0.008	8.995	0.029	0.458	0.137	22.151	-0.066	0.171	0.077

Table 3c
Investments in U.S., Euro-zone, U.K., and Japanese Assets:
Return, Risk, and Return to Variability Ratio (2002:01-2005:12)

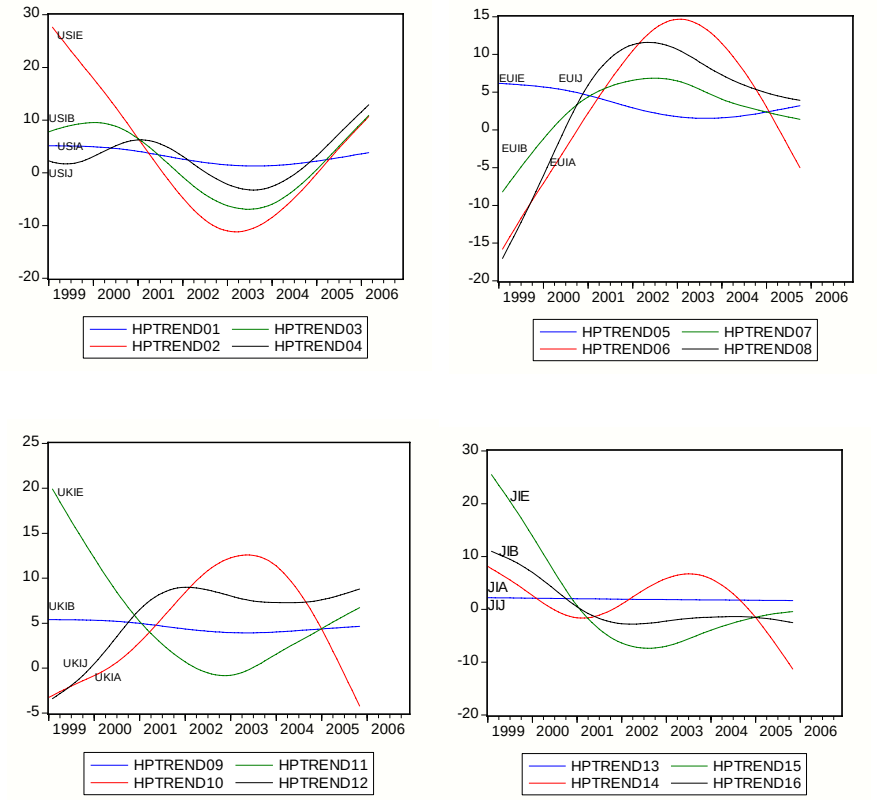
	i_{US}^{A}	i_{US}^{E}	i_{US}^{B}	i_{US}^{J}	i_{EU}^{E}	i_{EU}^{A}	i_{EU}^{B}	i_{EU}^{J}	i_{UK}^{B}	i_{UK}^{A}	i_{UK}^{E}	i_{UK}^{J}	i_{J}^{J}	i_{J}^{A}	i_{J}^{E}	i_{J}^{B}
$\bar{x}$	1.692	-6.117	-3.595	-1.048	1.943	9.752	4.465	7.012	4.086	9.372	1.564	6.633	1.789	4.529	-3.280	-0.758
σ_x	0.797	29.211	23.905	25.089	0.869	28.774	17.124	22.086	0.459	23.610	17.226	21.887	0.068	24.881	22.104	21.878
$\frac{i_x}{\sigma_x}$	2.123	-0.209	-0.150	-0.042	2.236	0.339	0.261	0.317	8.902	0.397	0.091	0.303	26.309	0.182	-0.148	-0.035

Note: See, Tables 1 and 2; $\dot{S}$ = growth of the U.S $/euro exchange rate ($\dot{S} \uparrow \Rightarrow \$ \downarrow$), and $\frac{i_x}{\sigma_x}$ = the return to variability ratio.

Source: See, Table 1.

Figure 1

Smooth Estimate of the L-T Trend of the Rates of Return in the U.S., the Euro-zone, the U.K., and in Japan: (Hodrick-Prescott Filter)



Note: USIA (i_{US}^{A})=the U.S. interest rate (nominal return) for an American investor, USIE(i_{US}^{E})=the U.S. return for a European investor, USIB (i_{US}^{B})=the U.S. return for a Briton investor, and USIJ (i_{US}^{J})=the U.S. return for a Japanese investor, EUIE (i_{EU}^{E})=the Euro-zone interest rate (nominal return) for a European investor, EUIA (i_{EU}^{A})=the Euro-zone return for an American investor, EUIB(i_{EU}^{B})=the Euro-zone return for a Briton investor, and EUIJ (i_{EU}^{J})=the U.S. return for a Japanese investor, UKIB (i_{UK}^{B})=the U.K. interest rate (nominal return) for a Briton investor, UKIA (i_{UK}^{A})=the U.K. return for an American investor, UKIE (i_{UK}^{E})=the U.K. return for a European investor, and UKIJ (i_{UK}^{J})=the U.K. return for a Japanese investor, JIJ (i_{J}^{J})=the Japanese interest rate (nominal return) for a Japanese investor, JIA (i_{J}^{A})=the Japanese return for an

American investor, JIE (i_J^E)=the Japanese return for a European investor, and JIB (i_J^B)=the Japanese return for a Briton investor, HPTREND=the Hodrick-Prescott filter, which shows a smooth estimate of the long-term trend of the interest rate.
Source: Economic Time Series Page by Eveline Tainer at http://www.economagic.com and hhtp://www.imfstatistics.org, and Kallianiotis (2006a).

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Stochastic Estimation of the Raw Materials Cost and the Determination of the Mean-Expected Total Product Cost: Analysis and Application.

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Abstract

The present paper offers an alternative way of estimating the mean expected cost of raw materials so as to improve the estimation of the expected total product-cost without expanding beyond the framework of measuring and controlling the efficiency of the business.

Apart from the estimation methodology proposed, the paper also focuses on the implications of the variance between expected and actual raw materials cost. In this respect, the paper is potentially interesting for managers because it offers new information that can help their decision making process in three different ways: first, it may help managers to redefine the targets of their business; second, it offers managers the insights that could help them take the required corrective actions; and third, it helps managers to better analyze the raw-materials variances in a way that the prevailing estimated cost is both realistic and effective.

Keywords: Raw materials cost, variances analysis, stochastic cost estimation.

JEL classification: M4, M49, C69.

1. Introduction

Many management accounting textbooks[1] place substantial emphasis on the fact that traditional costing systems do not allocate overheads to products properly and provide management with inaccurate and biased information about the costing of products or services. On practical grounds, however, many companies appear not to share this view with full enthusiasm and still prefer using costing systems that allocate overheads to products based on traditional volume-based measures[2]. Viewed in this light, employing traditional allocation rates (i.e. machine hours, direct labor hours) reduces the complexity of using other more sophisticated cost measurement methodologies, such as the theory of constraints (TOC), activity-based costing (ABC), throughput accounting, and target costing. Confronted with a large number of alternatives to traditional costing, managers are often confused and the dilemma of

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[1] See for example Kaplan and Cooper (1998), Drury (2000) and Garrison and Noreen (2003)

[2] See Horngren *et al.*(1997) for a review of such studies in the USA, the UK, Ireland, Japan and Sweden.

accuracy over simplicity unavoidably leads to the question as to whether which of the alternative methodologies provides with the most accurate cost information.

Although, in the academic literature activity-based costing prevails as the most widely advocated alternative[3], it is not uncommon to find authors that contribute ideas on how to improve traditional costing systems. Balakrishnan and Sivaramakrishnan (2002) and Banker and Hansen (2002) offer explanations for the tendency of firms to use full-cost information for pricing decisions and expose the reasons why companies show a continuous preference to traditional costing methods, towards more sophisticated costing methods. Lucas (1999, 2003) advocates that the lack of adequate empirical evidence has spread among accountants the misconception that full-cost information sufficiently approximates the required inputs for marginal costing optimal decision-making. Cheatham (1989) Johnsen and Sopariwala (2000), Wing (2000) and Emsley (2001) take another point of view and argue that full-cost information derived by traditional costing methods suffers from the fact that cost variances are either misleadingly calculated or the information concerning cost variances is discarded by senior management. Moreover, Emsley and Wing maintain that if proper attention is given to variance analysis then the information implicit in cost variances could be a relevant input in decision-making and problem solving.

The present paper develops a stochastic model for estimating mean-expected variances. The paper applies estimation procedures on the calculation of the variances of the predetermined direct materials cost, but the proposed model is also applicable on the calculation of other types of cost variances. The analysis is based on truncating cost variances in order to obtain estimates of predetermined cost that do not deviate significantly from the actual cost of a product. For the mathematical proofs of the model, the paper uses continuous analysis. However, the numerical application that follows uses discrete analysis making the model easily understood by both researchers and practitioners.

The proposed model attempts to improve full-cost information and enhances the information content of cost variances in pricing decisions. In doing so it improves the use of traditional costing systems by dissolving potential doubt about misleading information signals or complexity burdens imposed by the changing of cost accounting systems. On the other hand, however, it should be pointed out that the proposed model does not prevail as a competing methodology to alternative costing systems. On the contrary, with few modifications, the model can prove to be helpful under any costing system that uses historical data to calculate predetermined-allocation-rate variances.

The remainder of the paper is organized as follows. Section 2 discusses the assumptions required, and presents the development of a stochastic model for the estimation of the direct materials cost variance. Section 3 applies the model to a numerical example and exposes its practical usefulness. Section 4 summarizes conclusions and implications for further research, while the appendix at the end of the paper relaxes some distributional assumptions of the model.

[3] For example, Merchant and Shields (1993), Innes and Mitchell (1995) and Krumwiede (1998a, 1998b) reveal that activity based costing (ABC) can eliminate biases in the costing of products with diverse resource consumption. Dearman and Shields (2001) show that managers who make decisions based on traditional cost accounting information exhibit poorer judgment performance than managers who base their decision making process on ABC product-cost information. For an extensive review of the major studies in the area see Bjornenak and Mitchell (2002).

2. Development of the model

Assumptions

It is well known that full-production cost is composed by the following three main categories of costs:

A. Direct materials
B. Direct labor
C. Factory overhead

Having this in mind, the following simple assumptions are necessary for the development of the model.

1) Each period's expected actual cost is estimated (forecasted) at the end of the previous fiscal period.

2) The predetermined cost is estimated with statistical-quantitative methods and is considered to remain constant (fixed) thereafter.

3) The distributions of the random variables (actual quantity and price of direct \materials) are known in advance. This assumption does not necessarily imply that probabilities are determined from a theoretical probability distribution. Problems on practical grounds usually arise because the theoretical probability distribution can never be known with certainty. Instead, this assumption implies that a curve-fitting method is used to estimate a theoretical probability distribution underlying a given frequency distribution[4].

4) The random variables, used in the model (actual quantity and price of direct materials) may be either independent or dependent, and determine the form of the model to be followed.

5) The total expected variance (be it either positive or negative) is considered to be satisfactory when it does not exceed or fall short of the total expected average actual cost more than 2%. This truncation procedure assumes that the fixed predetermined cost is adjusted by adding or subtracting the expected variance depending on whether the variance is positive or negative. The resulting predetermined cost is considered as the new predetermined cost. The same procedure is repeated until the difference of the total variance does not exceed or fall short of the average actual cost more than the above-mentioned percentage. This procedure is applied in order to minimize possible omissions or mistakes.

Estimation of the direct materials variance

The total variance of the direct materials is the combined result of two secondary variances

a. The price variance of direct materials
b. The quantity variance of direct materials

[4] See for example Dickinson (1974), Hilliard and Leitch (1975),and Liao (1975)

Thus, the variance of the actual price of direct materials results from the equation: Variance of the price of direct material:

$$V_p = (P_A - P_E)\, Q_A \quad (1)$$

where,
P_A= Actual Price
P_E= Predetermined Price
Q_A= Actual Quantity

On the other hand, the quantity variance of direct materials is equal to

$$V_Q = (Q_A - Q_E)\, P_E \quad (2)$$

where:
Q_A= Actual Quantity
Q_E= Predetermined Quantity
P_E= Predetermined Price

It is clear from equations (1) and (2) that the price variance of direct materials $(P_A - P_E)\, Q_A$ is positive or favorable when $P_A < P_E$ and negative or unfavorable when $P_A > P_E$.

Accordingly, the quantities variance of direct materials $(Q_A - Q_E)\, P_E$ is positive or favorable when $Q_A < Q_E$ and negative or unfavorable when $Q_A > Q_E$. Therefore, on the assumption that the random variables Q_A and P_A are dependent, the expected variance of prices of direct materials results from the common distribution of Q_A and P_A that is $p_0(Q_A, P_A)$ with respect to the interval of Q_A and P_A. Thus we have:

Expected actual variance of prices= $E(V_P) =$

$$\int_0^{\infty}\int_0^{P_E} (P_A - P_E) Q_A\, p(Q_A, P_A)\, dQ_A dP_A + \int_0^{\infty}\int_{P_E}^{\infty} (P_A - P_E) Q_A\, p(Q_A, P_A)\, dQ_A dP_A \quad (3)$$

Expected actual variance of quantities= $E(V_Q) =$

$$\int_0^{Q_E} (Q_A - Q_E) P_E\, p_0(Q_A)\, dQ_A + \int_{Q_E}^{\infty} (Q_A - Q_E) P_E\, p_0(Q_A)\, dQ_A \quad (4)$$

the total variance is equal to the sum of the two secondary variances that is:

Total variance= $E(V) = E(V_P) + E(V_Q) =$

$$\int_0^{\infty}\int_0^{P_E} (P_A - P_E) Q_A\, p(Q_A, P_A)\, dQ_A dP_A + \int_0^{\infty}\int_{P_E}^{\infty} (P_A - P_E) Q_A\, p(Q_A, P_A)\, dQ_A dP_A + \int_0^{Q_E} (Q_A - Q_E) P_E\, p_0(Q_A)\, dQ_A + \int_{Q_E}^{\infty} (Q_A - Q_E) P_E\, p_0(Q_A)\, dQ_A \quad (5)$$

In the case where the random variables Q_A, P_A are independent and the distribution of their probability is p_0 (Q_A) and p_0 (P_A) with respect to the interval of Q_A and P_A, then the secondary variances are as follows:

Expected actual variance of prices of direct material= $E(V_P)$ =

$$\int_0^{\infty}\int_0^{P_E}(P_A-P_E)Q_A p_0(Q_A)p_0(P_A)dQ_A dP_A+\int_0^{\infty}\int_{P_E}^{\infty}(P_A-P_E)Q_A p_0(Q_A)p_0(P_A)dQ_A dP_A \quad (6)$$

Expected variance of quantity of direct material= $E(V_Q)$ =

$$\int_0^{Q_E}(Q_A-Q_E)P_E\,p_0(Q_A)dQ_A+\int_{Q_E}^{\infty}(Q_A-Q_E)P_E\,p_0(Q_A)dQ_A \quad (7)$$

Having calculating the secondary variances the total expected variance is estimated as the sum of $E(V_P)$ and $E(V_Q)$. It follows from equations (6) and (7) that:

$$\mathbf{E(V)}=\int_0^{\infty}\int_0^{P_E}(P_A-P_E)Q_A p_0(Q_A)p_0(P_A)dP_A dQ_A+$$

$$+\int_0^{\infty}\int_{P_E}^{\infty}(P_A-P_E)Q_A p_0(Q_A)p_0(P_A)dP_A dQ_A \quad +\int_0^{Q_E}(Q_A-Q_E)P_E\,p_0(Q_A)dQ_A \quad +$$

$$+\int_{Q_E}^{\infty}(Q_A-Q_E)P_E\,p_0(Q_A)dQ_A \quad (8)$$

which after rearranging terms yields:

$$\int_0^{Q_E}\int_0^{P_E}(P_A-P_E)Q_A p_0(Q_A)p_0(P_A)dP_A dQ_A \quad +$$

$$+\int_{Q_E}^{\infty}\int_0^{P_E}(P_A-P_E)Q_A p_0(Q_A)p_0(P_A)dP_A dQ_A \quad +$$

$$+\int_0^{Q_E}\int_{P_E}^{\infty}(P_A-P_E)Q_A p_0(Q_A)p_0(P_A)dP_A dQ_A \quad +$$

$$+\int_{Q_E}^{\infty}\int_{P_E}^{\infty}(P_A-P_E)Q_A p_0(Q_A)p_0(P_A)dP_A dQ_A \quad +\int_0^{Q_E}(Q_A-Q_E)P_E\,p_0(Q_A)dQ_A \quad +$$

$$+\int_{Q_E}^{\infty}(Q_A-Q_E)P_E\,p_0(Q_A)dQ_A \quad (9)$$

or equivalently

$$\int_0^{Q_E}\left[(Q_A-Q_E)P_E+\int_0^{P_E}(P_A-P_E)Q_A p_0(P_A)dP_A\right]p_0(Q_A)dQ_A$$
$$+\int_{Q_E}^{\infty}[(Q_A-Q_E)P_E+\int_0^{P_E}(P_A-P_E)Q_A P_0(P_A)dP_A]p_0(Q_A)dQ_A +$$
$$+\int_0^{Q_E}\int_{P_E}^{\infty}(P_A-P_E)Q_A\ p_0(Q_A)\ p_0(P_A)\ dP_A\,\mathrm{d}\,Q_A +$$
$$+\int_{Q_E}^{\infty}\int_{P_E}^{\infty}(P_A-P_E)Q_A p_0(Q_A)p_0(P_A)dP_A dQ_A \qquad (10)$$

Equations (5) and (10) constitute the two mathematical models for estimating the cost variances of direct material, irrespective of whether the random variables are assumed to be dependent or independent.

3. Numerical Application

This section uses a numerical example to show how the model could be used in practical situations. The example simplifies the analysis by using discrete time framework and assumes that the probability distributions of the random variables have been estimated on the basis of historical data.

Let the XYZ Company manufacture T-shirts at several plants locked in different locations. The production department predetermined the direct material cost for the next fiscal year as follows:

a) 3kgs of thread per batch of hundred T-shirts is needed
b) the thread costs $350 per kg

Normal production is set at 1,000 batches and the company's headquarters wish to determine a price that gives a competitive edge. Thus, it is required to predetermine the expected actual cost of the direct material needed for the production. In order to do so, the method of estimating the variance of the actual direct material cost with respect to the predetermined costs is applied.

For simplicity, it is assumed that the actual price and quantity are distinct, random variables, independent from each other. Moreover the probability distribution of the random variables has been estimated as follows:

Table 1

Max.Predetermined quantity Q_E	Probability of $Q_A = Q_E$	Cumulative probability of Q_A	Max. actual quantity E (Q_A)
2	0.00	0.00	0.00
3	0.95	0.95	2.85
4	0.05	1.00	0.20
			E (Q_A)=3.05

Table2

Min.Predetermined quantity Q_E	**Probability of $Q_A = Q_E$**	**Cumulative probability of Q_A**	**Min. actual quantity E (Q_A)**
2	0.80	0.80	1.60
3	0.15	0.95	0.45
4	0.05	1.00	0.20
			E (Q_A)=2.25

Table3

Max.Predetermined price P_E	**Probability of $P_A = P_E$**	**Cumulative probability of P_A**	**Max. actual price E (P_A)**
250	0.05	0.05	12.50
350	0.90	0.95	315.00
400	0.05	1.00	20.00
			347.50

Table 4

Min.Predetermined price P_E	**Probability of $P_A = P_E$**	**Cumulative probability of P_A**	**Min. actual price E (P_A)**
200	0.60	0.60	120
300	0.30	0.90	90
350	0.10	1.00	33
400	0.00	1.00	0
			245

Table5

	E (Q_A)	$\sum_{0}^{Q_E} p_0(Q_A)$	$\sum_{Q_{E+1}}^{\infty} p_0(Q_A)$	**Total Quantity E(Q_A)**
Maximum	3.05	0.98		2.989
Minimum	2.25		0.02	0.045
				3.034

Table 6

	E(P_A)	$\sum_{0}^{P_E} p_0(P_A)$	$\sum_{P_{E+1}}^{\infty} p_0(P_A)$	**Total price E (P_A)**
Maximum	347.50	0.98		340.55
Minimum	245.00		0.02	4.90
				345.45

The total variance is the sum of the variance of price and quantity of the direct material. According to equation 10, (taken in discrete form) it follows that:

$$\sum_0^{Q_E}[(Q_A-Q_E)P_E+\sum_0^{P_E}(P_A-P_E)Q_Ap_0(P_A)]p_0(Q_A)+\sum_{Q_E+1}^{\infty}[(Q_A-Q_E)P_E$$
$$+\sum_0^{P_E}(P_A-P_E)Q_Ap_0(P_A)]p_0(Q_A)\ +\sum_0^{Q_E}[\sum_{P_E+1}^{\infty}(P_A-P_E)Q_Ap_0(P_A)p_0(Q_A)]$$
$$+\ \sum_{Q_E+1}^{\infty}\ [\sum_{P_E+1}^{\infty}(P_A-P_E)Q_Ap_0(P_A)p_0(Q_A)]$$

Substituting the data given in tables (1) to (6) yields:

0.98[(3.05-3) 350+0.98(347.50-350) 3.05]+0.02[(2.25-3) 350+0.98(347.50-350) 3.05]+0.98[0.02(245-350) 3.05]+0.02[0.02(245-350) 2.25]=$ -1.93

The absolute value of the variance per unit produced, that has been calculated lies within the preset limit of 2% since the total actual average cost of the direct material is 3.034*345.45=$ 1048.09 and the 2% amount of the actual cost is $ 20.962.

4. Concluding Remarks

The present paper provides a stochastic model of estimating the variance between the actual and the predetermined cost of the direct material. The method developed in the paper involves truncating cost variances and results in predetermined costs being very close to actual costs. The model may be useful for both practitioners and academics for four main reasons:

First, when the selling price depends on the direct material costs, the calculation of the cost variance according to the model provides management with sufficient information to set competitive prices in the market.

Second, this method provides the management with the opportunity to decide whether it is more profitable to either buy or manufacture a product. It also gives the means for comparing the production cost with the prevailing prices in the market.

Third, the determination of the direct material costs using the variance method (when the direct labor and factory overhead cost are known), helps the manager to estimate the financing requirements of the product-manufacturing process.

Fourth, with few modifications, the model can also be applied for estimating the variance of direct labor costs. Moreover, the model consists of a way of truncating variances under any costing system. However, this consists of an implication for future research and expands beyond the scope of the present paper.

Appendix

This appendix applies the results of the paper in the special case where the random variables are assumed to follow some parametric distributions, such as the normal or lognormal distribution:

Normal distribution:

$$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left\{-\frac{1}{2\sigma^2}(x-\mu)^2\right\}dx$$

Truncate normal: $A \leq x \leq B$

$$E(x \mid A \leq x \leq B) = \mu + \frac{f\left(\frac{A-\mu}{\sigma}\right) - f\left(\frac{B-\mu}{\sigma}\right)}{\Phi\left(\frac{B-\mu}{\sigma}\right) - \Phi\left(\frac{A-\mu}{\sigma}\right)}\sigma$$

where: $$f\left(\frac{A-\mu}{\sigma}\right) = \frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2\sigma^2}(A-\mu)^2\right\}$$

$$f\left(\frac{B-\mu}{\sigma}\right) = \frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2\sigma^2}(B-\mu)^2\right\}$$

if $A=-\infty$ $f(\cdot)=0$ $\Phi(\cdot)=0$

$B=+\infty$ $f(\cdot)=0$ $\Phi(\cdot)=1$

μ: is the unconditional mean of x

σ: standard deviation of x

$\Phi(z) = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2}s^2\right\}ds$: is the area from $-\infty$ to z under the standard normal distribution

This result can be used to evaluate the integral when Q_A and P_A are stochastically independent. For example,

$$\int_0^{Q_E} (Q_A - Q_E)P_E\, p_0(Q_A)dQ_A = P_E \int_0^{Q_E} Q_A p_0(Q_A)dQ_A - P_E Q_E \int_0^{Q_E} p_0(Q_A)dQ_A =$$

$$= P_E\left[\Phi_0\left(\frac{Q_E-\mu}{\sigma}\right)-\Phi_0\left(\frac{0-\mu}{\sigma}\right)\right]\frac{\int_0^{Q_E} Q_A p_0(Q_A)dQ_A}{\left[\Phi_0\left(\frac{Q_E-\mu}{\sigma}\right)-\Phi_0\left(\frac{0-\mu}{\sigma}\right)\right]} - P_E Q_E \int_0^{Q_E} p_0(Q_A)dQ_A =$$

$$= P_E\left[\Phi_0\left(\frac{Q_E-\mu}{\sigma}\right)-\Phi_0\left(\frac{0-\mu}{\sigma}\right)\right], \mathrm{E}\,(Q_A \mid 0 \le Q_A \le Q_E)$$

$$= P_E Q_E \left[\Phi_0\left(\frac{Q_E-\mu}{\sigma}\right)-\Phi_0\left(-\frac{\mu}{\sigma}\right)\right] =$$

$$= \left[\Phi_0\left(\frac{Q_E-\mu}{\sigma}\right)-\Phi_0\left(-\frac{\mu}{\sigma}\right)\right] \quad [P_E \quad E(Q_A \mid 0 \le Q_A \le Q_E) - P_E Q_E]$$

where:

$$E(Q_A \mid 0 \le Q_A \le Q_E) = \mu + \frac{f\left(-\frac{\mu}{\sigma}\right) - f\left(\frac{Q_E-\mu}{\sigma}\right)}{\Phi\left(\frac{Q_E-\mu}{\sigma}\right)-\Phi\left(-\frac{\mu}{\sigma}\right)}\,\sigma$$

Note: The density function of Q_A, conditional on $Q_A \ge 0$, is given by:

$$f(Q_A \mid Q_A \ge 0) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left\{-\frac{1}{2\sigma^2}(Q_A-\mu)^2\right\} \frac{1}{1-\Phi\left(-\frac{\mu}{\sigma}\right)}$$

where: $\left.\begin{array}{l}\mu = E(Q_A)\\ \sigma^2 = Var(Q_A)\end{array}\right\}$ unconditional

In this case: $\int_0^{Q_E} Q_A f_0(Q_A \mid Q_A \ge 0)dQ_A =$

$$= \frac{1}{1-\Phi_0\left(-\frac{\mu}{\sigma}\right)} \int_0^{Q_E} Q_A f_0(Q_A)dQ_A =$$

$$= \frac{1}{1-\Phi_0\left(-\frac{\mu}{\sigma}\right)}\left[\Phi_0\left(\frac{Q_E-\mu}{\sigma}\right)-\Phi_0\left(-\frac{\mu}{\sigma}\right)\right] \quad \mathrm{E}\,(Q_A \mid 0 \le Q_A \le Q_E)$$

$$= \frac{\left[\Phi_0\left(\frac{Q_E-\mu}{\sigma}\right)-\Phi_0\left(-\frac{\mu}{\sigma}\right)\right]}{1-\Phi_0\left(-\frac{\mu}{\sigma}\right)} \left(\mu+\frac{f_0\left(-\frac{\mu}{\sigma}\right)-f_0\left(\frac{Q_E-\mu}{\sigma}\right)}{\Phi_0\left(\frac{Q_E-\mu}{\sigma}\right)-\Phi_0\left(-\frac{\mu}{\sigma}\right)}\right)$$

It is quite clear, that the quantity $\int_{Q_E}^{\infty} Q_A p_1(Q_A) dQ_A$ can also be expressed in a similar manner.

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The Main Determinants of Economic Growth: An Empirical Investigation with Granger Causality Analysis for Greece

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Abstract

This paper examines empirically the causal relationship among exports, gross capital formation, foreign direct investments and economic growth using a multivariate autoregressive Var model for Greece over the period 1960-2002. The results of cointegration test suggested that there is only one cointegrated vector between the examined variables, while Granger causality tests showed that there is a unidirectional causal relationship between exports and gross fixed capital formation and also there is a unidirectional causal relationship between foreign direct investments and economic growth.

Keywords*:* Exports, investments, economic growth, Granger causality

JEL classification: O10, C22.

1. Introduction

There is a large part of economic theory analyzing the causal relationship between exports and economic growth. Certainly, since exports consist one of the main determinants of economic growth, an increase of exports contributes to an increase of economic growth. However, there are also some other indirect factors, which affect the causal relationship between exports and economic growth.

Ricardo in his study in 1817, notes that trade facilitates products output with a comparative advantage in a country resulting to a higher level of national wealth. Recent empirical studies are less convincing relating to the causal relationship between exports and economic growth, because the main interest focuses on which methods are used for economic growth through trade expansion.

The basic a priori argument is that exports expansion contributes to economic growth increasing the percentage of gross fixed capital formation and productivity factor.

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If there are incentives for investments growth and technology advance the marginal productivity factors are expected to be higher in exporting sector than the remain economic ones.

Since the ratio of exports to gross domestic product denotes an open economy index, a higher ratio indicates a relatively higher open economy. On the other hand a lower ratio of exports to gross domestic product reflects to a limited trade policy and a more close economy.

Solow (1956) in his study suggests that the larger the investment and saving rate are the more cumulative capital per worker is produced.

Tyler (1981) examining a sample of 55 developing countries resulted that exports and investments are the main determinants of economic growth.

New growth theories stress the importance of investments, human and physical capital in the long-run economic growth. The policies, which affect the level of growth and the investment efficiency, determine the long-run economic growth.

Theoretically, the gross capital formation affects the economic growth either increasing the physical capital stock in domestic economy directly, Plossner (1992) or promoting the technology indirectly, Levine and Renelt (1992).

Recently, many empirical studies emphasized in diversified role of private and public investments in growth process. The public investments on infrastructure, in extent in which are proved to be complementary to the private investments, can increase the marginal product of the private capital, augmenting the growth rate of a domestic economy.

Khan and Kumar (1997) supported that the effects of private and public investments on economic growth differ significantly, with private investment to be more productive than public one. Knight, Loyaza and Villanueva (1993) and Nelson and Singh (1994) confirmed that public investments on infrastructure have an important positive effect on economic growth over the period 1980-1990. Easterly and Rebelo (1993) evaluated that public investments on transportation and communications are positively correlated to economic growth, while there were negative effects of public investments of state-owned businesses on economic growth.

The effect of foreign direct investment on economic growth is dependent on the level of technological advance of a host economy, the economic stability, the state investment policy and the degree of openness. FDI inflows can affect capital formation because they are a source of financing and capital formation is one of the prime determinants of economic growth. Inward FDI may increase a host's country productivity and change its comparative advantage. If productivity growth were export biased then FDI would affect both growth and exports. A host's country institutional characteristics such as its legal system, enforcement of property rights, could influence simultaneously the extent of FDI and inflows and capital formation in that country.

Blomstoerm, Lipsey, Zejan (1994) found a unidirectional causal relationship between FDI inflows as a percentage of GDP and the growth of per capita GDP for all developed countries over the period 1960-1985.

O Zhang (1999) examines the causal relationship between foreign direct investment and economic growth with Granger causality analysis for 10 Asian countries. The results of this study suggested that there is a unidirectional causality between foreign direct investment and economic growth with direction from FDI to GDP in Hong Kong,

Japan, Singapore, Taiwan, a unidirectional causality between exports and economic growth with direction from economic growth to exports for Malaysia and Thailand, also there is a bilateral causal relationship between FDI and GDP for Kina and Indonesia, while there is no causality for Korea and Philippines.

Borensztein, De Gregorio and Lee (1998) highlight the role of FDI as an important vehicle of economic growth only in the case that there is a sufficient absorptive capability in the host economy. This capability is dependent on the achievement of a minimum threshold of human capital.

Moudatsou (2003) suggested that FDI inflows have a positive effect on economic growth in European Union countries both directly and indirectly through trade reinforcement over the period 1980-1996.

In the empirical analysis of this paper we use annual data for the period 1960-2002 for all variables. The remainder of the paper proceeds as follows: Section 2 describes the data and the specification of the multivariate VAR model that is used. Section 3 employs with Dickey-Fuller tests and examines the data stationarity. Section 4 presents the cointegration analysis and Johansen cointegration test. Section 5 analyses the estimations of error correction models, while section 6 summarizes the Granger causality tests. Finally, section 7 provides the final conclusions of this paper.

2. Data and specification of the model

In this study the method of vector autoregressive model (VAR) is adopted to estimate the effects of economic growth on exports, gross capital formation and foreign direct investments. The use of this methodology let us recognize the cumulative effects taking into acount the dynamic response between economic growth and the other variables (Pereira and Hu 2000).

In time series analysis the appropriate differential is significant because the most algorithms estimations fail when time series are not stationary. Also efficient benefits may exist in their 1st differences. In small samples the distributions of the coefficients (estimators) may be improved by the estimation of (VAR) vector autoregressive model in their 1st differences (Hamilton 1994). Also, the use of 1st differences in econometric studies facilitates the results explanation (interpretation), since the first differences of logarithms of initial variables represent the rate of change of these variables (Dritsakis 2003).

In order to test the causal relationships discussed above (introduction) we specify the following multivariate VAR model:

$$GDPN = f\left(EXPG, INVG, FDIG\right) \quad (1)$$

where:

$$GDPN = \frac{GDP}{N} \quad per\ capita\ GDP$$

$EXPG = \frac{EXP}{GDP}$ *the ratio of exports to GDP*

$INVG = \frac{INV}{GDP}$ *the ratio of gross capital formation to GDP*

$FDIG = \frac{FDI}{GDP}$ *the ratio of foreign direct investments to GDP*

N = *population*

The variable of economic growth (GDP) is measured by real GDP adjusted by GDP deflator. The variable of gross fixed capital formation (INV) adjusted by GDP deflator. The variable of exports is measured by real revenues of exports and is obtained by adjusting the nominal price of exports based on the database of International Financial Statistics (IFS). The variable of FDI is measured by foreign direct investments adjusted by GDP deflator. The data that are used in this analysis are annual, cover the period 1960-2002 regarding 1996 as a base year and are obtained from International Monetary Fund (IMF).

All data are expressed in logarithms in order to include the proliferative effect of time series and are symbolized with the letter L preceding each variable name. If these variables share a common stochastic trend and their first differences are stationary, then they can be cointegrated.

Economic theory scarcely provides some guidance for which variables appear to have a stochastic trend and when these trends are common among the examined variables as well. For the analysis of the multivariate time series that include stochastic trends, the Augmented Dickey-Fuller (1979) (ADF) unit root test is used for the estimation of individual time series with intention to provide evidence for when the variables are integrated. This is followed by multivariate cointegration analysis.

3. Unit root test

The cointegration test among the variables that are used in the above model requires previously the test for the existence of unit root for each variable and especially, for per capita gross domestic product (GDP) and the ratio of exports to GDP, the ratio of gross fixed capital formation to GDP, the ratio of foreign direct investment to GDP, using the Augmented Dickey-Fuller (ADF) (1979) test on the following regression:

$$\Delta X_t = \delta_0 + \delta_1 t + \delta_2 X_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta X_{t-i} + u_t \quad (2)$$

The ADF regression tests for the existence of unit root of X_t, namely in the logarithm of all model variables at time t. The variable ΔX_{t-i} expresses the first differences with k lags and final u_t is the variable that adjusts the errors of autocorrelation. The coefficients δ_0, δ_1, δ_2, and α_i are being estimated. The null and the alternative hypothesis for the existence of unit root in variable X_t is:

$$H_o : \delta_2 = 0 \qquad H_\varepsilon : \delta_2 < 0$$

The results of these tests appear in Table 1. The minimum values of the Akaike (AIC) and Schwartz (SC) statistics have provided the better structure of the ADF equations as well as the relative numbers of time lags, under the indication "Lag". As far as the autocorrelation disturbance term test is concerned, the Lagrange Multiplier LM(1) test has been used. The MFIT 4.0 (1997) econometric package that was used for the estimation of ADF test, provides us the simulated critical values.

Table 1 – DF/ADF unit root tests

Variables	In their levels			1st differences		
	Lag	Test statistic (DF/ADF)	LM(1)	Lag	Test statistic (DF/ADF)	LM(1)
LGDPN	1	-1.2597	4.7667 [0.029]	0	-9.2408	3.6308 [0.057]
LEXPG	0	-1.7145	2.6045 [0.107]	0	-5.4241	0.3377 [0.561]
LINVG	1	-2.5541	0.0164 [0.898]	1	-4.6952	0.7972 [0.372]
LFDIG	0	-1.6875	0.1020 [0.749]	1	-8.5286	0.11454 [0.735]

Critical value: -3.4547

The results of Table 1 suggest that the null hypothesis of a unit root in the time series cannot be rejected at a 5% level of significance in variable levels. Therefore, no time series appear to be stationary in variable levels. However, when the logarithms of the time series are transformed into their first differences, they become stationary and consequently the related variables can be characterized integrated of order one, I(1*)*. Moreover, for all variables the LM(1) test in their first differences show that there is no correlation in the disturbance terms.

4. Cointegration and Johansen test

If the time series (variables) are non-stationary in their levels, they can be integrated with integration order 1, when their first differences are stationary. These

variables can be cointegrated as well if there are one or more linear combinations among the variables that are stationary. If these variables are being cointegrated then there is a constant long-run linear relationship among them.

Since it has been determined that the variables under examination are integrated of order 1, the cointegration test is performed. The testing hypothesis is the null of non-cointegration against the alternative that is the existence of cointegration using the Johansen (1988) maximum likelihood procedure Johansen and Juselious (1990, 1992). An autoregressive coefficient is used for the modelling of each variable (that is regarded as endogenous) as a function of all lagged endogenous variables of the model.

Given the fact that in order to apply the Johansen technique a sufficient number of time lags is required, we have followed the relative procedure, which is based on the calculation LR (Likelihood Ratio) test statistic (Sims, 1980). The results showed that the value ρ=3 is the appropriate specification for the above relationship. Further on we determine the cointegration vectors of the model, under the condition that matrix Π has an order r<n (n=4). The procedure of calculating order r is related to the estimation of the characteristic roots (eigenvalues), which are the following:

Table 2 - Johansen and Juselious Cointegration Tests

Variables LGDPN, LEXPG, LINVG, LFDIG

Maximum lag in VAR = 3

$\hat{\lambda}_1 = 0.55810$ $\hat{\lambda}_2 = 0.41975$ $\hat{\lambda}_3 = 0.27780$ $\hat{\lambda}_4 = 0.14297$

Eigenvalues			Critical Values	
Null	Alternative	Eigenvalue	95%	90%
r = 0	r = 1	31.8501	31.7900	29.1300
r = 1	r = 2	21.2273	25.4200	23.1000

Trace Statistic			Critical Values	
Null	Alternative	Eigenvalue	95%	90%
r = 0	r > 0	71.7872	63.0000	59.1600
r ≤ 1	r > 1	39.1371	42.3400	39.3400

The results that appear in Table 2 suggest that the number of statistically significant cointegration vectors is equal to 1 and is the following one:

LGDPN = 0.23883LEXPG + 0.46903LINVG + 0.46774LFDIG

The coefficients' estimates in equilibrium relationships whch are essentially the long-run estimated elasticities relative to economic growth suggest that gross domestic product, exports, and foreign direct investments are inelastic to per capita GDP. According to the signs of the vector cointegration components and based on the basis of economic theory the above relationships can be used as an error correction mechanism in a VAR model.

5. A VAR model with an error correction mechanism

After determining that the logarithms of the model variables are cointegrated, we must estimate then a VAR model in which we shall include a mechanism of error correction model (MEC). The error correction model arises from the long-run cointegration relationship and has the following form:

$$\Delta LGDPN_t = \text{lagged}\,(\Delta LGDPN_t\,,\ \Delta LEXPG_t,\ \Delta LINVG_t,\ \Delta LFDIG_t\,) + \lambda\, u_{t-1} + V_t \qquad (3)$$

where Δ is reported to first differences of variables
u_{t-1} are the estimated residuals from the cointegrated regression (long-run relationship) and represents the deviation from the equilibrium in time period t.

$-1<\lambda<0$ short-run parameter

V_t white noise disturbance term.

One difficulty, which a researcher faces with the estimation of an autoregressive VAR model, is the appropriate specification of the model. Specially, the researcher has to decide which deterministic components should be included and which number of lags should be used as well.

Since arbitrarily selected specifications of the autoregressive VAR model are possible to produce unreliable results, we use the selection criterion of a database model in order to specify the autoregressive VAR model for Greek economy. Among the different selection criteria of the model the one that was suggested by Schwartz (1978), known as Schwartz Bayesian information criterion seems to outperform other alternative solutions (Mills and Prasad 1992). Therefore, the specification of the autoregressive VAR model is based on the Schwartz Bayesian information criterion. Also, first order specification of the model VAR (1) is selected with a constant and a time trend.

The final form of the Error-Correction Model was selected according to the approach suggested by Hendry (Maddala 1992). The initial order of time lag for the

model is 2 because it is large enough to enclose the system's short-run dynamic. We also apply a number of diagnostic tests on the residuals of the model. We apply the Lagrange test for the residuals' autocorrelation, the heteroscedasticity test and the Bera-Jarque normality test. We also test the functional form of the model according to the Ramsey's Reset test. Error correction model is appeared in table 3.

Table 3. Error Correction Model

$$\Delta LGDPN_t = \underset{\substack{(0.3444)\\[0.733]}}{0.00166} + \underset{\substack{(0.6400)\\[0.526]}}{0.03324}\Delta LEXP_{t-1} + \underset{\substack{(1.7021)\\[0.098]}}{0.0993}\,\Delta LINVG_{t-2} + \underset{\substack{(1.9501)\\[0.059]}}{0.03158}\Delta LFDIG_{t-1}$$

$$- \underset{\substack{(-3.5030)\\[0.001]}}{0.48911}\, u_{t-1}$$

$\overline{R}^2 = 0.4054$ F(4,34) = 7.4809 [0.000] DW = 2.0946

A: $X^2[1] = 0.2796$ [0.597] B: $X^2[1] = 0.0082$ [0.927]

C: $X^2[2] = 2.4048$ [0.300] D: $X^2[1] = 2.3628$ [0.124]

Notes:

Δ: Denotes the first differences of the variables.
$\overline{R}^2$ = Coefficient of multiple determination adjusted for the degrees of freedom (d.f).
DW= Durbin-Watson statistic.
F(n, m)= F-statistic with n,m d.f respectively.
A: $X^2(n)$ Lagrange multiplier test of residual serial correlation, following x^2 distribution with n d.f.
B: $X^2(n)$ Ramsey's Reset test for the functional form of the model, following x^2 distribution with n d.f.
C: $X^2(n)$: Normality test based on a test of skewness and kurtosis of residuals, following x^2 distr with n d.f.
D: $X^2(n)$: Heteroscedasticity test, following x^2 distribution
( )= We denote the t-ratio for the corresponding estimated regression coefficient.
[ ]= We denote prob. levels.

We do not reject the estimations, which are based on the results of table 3 according to the statistical and diagnostic tests in 10% level of significance (except the variable of exports). The percentage of the total variation of the dependent variable that is described in our model is high enough (40%). The Error-Correction Term is statistically significant and has a negative sign, which confirms that the long-run equilibrium relation between the independent and dependent variablesin 5% level of significance. Their relative price denotes 0.48912 (-3.5030) a satisfactory convergence rate to equilibrium point per period.

From the results of table 3 we can infer that in the long-run an increase of 1% on ratio of exports to GDP will lead to an increase of 0.033% on per capita GDP, an increase

of 1% on the ratio of gross fixed capital formation to GDP will lead to an increase of 0.09% on per capita GDP, while increase of 1% on ratio of foreign direct investment to GDP will lead to an increase of 0.031% on per capita GDP.

6. Granger causality test

The model that was estimated in the previous section was used in order to examine the Granger causal relationships between the variables under examination. As a testing criterion the F statistic was used. With the F statistic the hypothesis of statistic significance of specific groups of explanatory variables was tested for each separate function. The results relating to the existence of Granger causal relationships between the variables: the per capita GDP, the ratio of exports to GDP, the ratio of gross fixed capital formation to GDP, the ratio of foreign direct investment to GDP appear in Table 4.

Table 4 – Granger causality tests

Dependent variable	Testing hypothesis	F1	F2
LGDPN	LEXPG there is no causality (LGDPN $\neq$ LEXPG)	0.323	2.480
	LINVG there is no causality (LGDPN $\neq$ LINVG)	2.894	0.457
	LFDIG there is a unidirectional relationship (LGDPN $\Leftarrow$ LFDIG)	6.171	0.740
LEXPG	LINVG there is a unidirectional relationship (LEXPG $\Leftarrow$ LINVG)	6.468	1.970
	LFDIG there is a unidirectional relationship (LEXPG $\Rightarrow$ LFDIG)	1.986	3.652
LINVG	LFDIG there is no causality (LINVG $\neq$ LFDIG)	0.007	0.100

Critical value: 3,07

From the results of table 4 we can infer that:

There is a unidirectional causal relationship between the ratio of foreign direct investments to GDP and the per capita GDP with direction from foreign direct investments to per capita GDP, a unidirectional causal relationship between the ratio of exports to GDP and the ratio of gross fixed capital formation to GDP with direction from gross fixed capital formation to exports and final a unidirectional causal relationship between the ratio of exports to GDP and the ratio of foreign direct investments to GDP with direction from exports to foreign direct investments. Also, there is no causal relationship between the per capita GDP and the ratio of exports to GDP, between the ratio of gross fixed capital formation to GDP and the per capita GDP and between the ratio of gross fixed capital formation to GDP and the ratio of of foreign direct investments to GDP.

6. Conclusions

In this paper an effort was made in order to examine the relationship among the per capita GDP, the ratio of exports to GDP, the ratio of gross fixed capital formation to GDP, the ratio of gross fixed capital formation to GDP and the ratio of of foreign direct investments to GDP, using annual data over the period 1960-2002.

The empirical analysis suggested that the examined variables present a unit root. On this basis the Johansen cointegration test analysis was used to lead to long-run equilibrium relationships among these variables. Then the methodology of error correction model was applied to estimate the short-run and the long-run relationships. The selected cointegrated vectors gave us the appropriate error correction terms, which proved to be statistically significant at a 5% level of significance during their inclusion to the short-run dynamic equations.

Final, through Granger causality test we can infer that there is a unidirectional causal relationship between the ratio of foreign direct investments to GDP and the per capita GDP with direction from foreign direct investments to per capita GDP, between the ratio of exports to GDP and the ratio of gross fixed capital formation to GDP and between the ratio of exports to GDP and the ratio of foreign direct investments to GDP as well.

Moreover, there is no causal relationship between the per capita GDP and the ratio of exports to GDP, between the ratio of gross fixed capital formation to GDP and the per capita GDP and between the ratio of gross fixed capital formation to GDP and the ratio of foreign direct investments to GDP.

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"How Effective are the Regional Policies of Convergence in the EU?"

by
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Abstract

In this paper an attempt is made to examine the impact of the convergence policies on regional development and the economic and social variations inside the EU according to the existing literature. An attempt is also made to look at the outcome of the EU intervention on the administrative and bureaucratic structures in the affected nations. We conclude that despite some advances in administration, monitoring and evaluation, the effect of the convergence policies on growth and efficiency remains restricted.

Keywords: European integration; Regional policy; Regional economics; Structural policies; Economic development.

JEL classification: R11, R58, O1, F15.

1. Introduction

This paper aims to explore whether convergence has taken place in the European regions, examining the success of the regional policies of convergence, their accomplishment, and also the bureaucratic and administrative relationships between Brussels and the nations involved, based on a critical examination of the related literature. The paper consists of these parts: First, theories of convergence and divergence are discussed and the empirical evidence of convergence and divergence in Europe is looked at, next the accomplishment of the European Union (EU) regional policy and especially the Structural Funds, from a political and economic standpoint up to the present time.

2. Theories for convergence and divergence

Economists, economic geographers and regional scientists have suggested different and contrasting explanations of why regions grow at different rates, and what kind of convergence, if any, one might expect from a system of interacting regions. Despite significant differences of approach, there are nevertheless common themes arising from the literature which bring an element of cohesion to a diverse subject matter, namely the relevance for understanding of returns to scale, externalities and catch up mechanisms, and the role of exogenous shocks in real-world turbulence (Fingleton, 2002).

According to classic growth theory, regional integration ought to lead to convergence. According to the neoclassical form of growth theory, rich and poor

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regions will converge. The neo-classical form of growth theory suggests that rich and poor regions will converge. It is the decreasing returns to scale to capital which brings about convergence: A higher marginal product and return to capital is to be expected from countries and regions with low capital stocks and per capita income. As a result of this there should be more capital accumulation and quicker growth in poor regions than in rich ones (Barro and Sala-i-Martin, 1995).

There has been a renewal of interest in the causes of economic convergence since 1985 (Sala-i-Martin, 1996). One reason for this is a revival of interest in the general subject of economic growth. The convergence hypothesis, which differentiates between the two main current approaches to economic growth - namely, the models of endogenous growth and the neoclassical model - has been instrumental in bringing about this revival. It was argued by Romer (1986) and Rebelo (1991) that the lack of convergence across economies worldwide suggests that the theories of endogenous growth are nearer to the reality in comparison to the neoclassical model.

The economists' hopeful forecast has been altered by two important trends in the literature of late: in contrast to the neoclassical paradigm, the "new growth theory" (Romer, 1990; Krugman, 1991c; Matsuyama, 1991) - which emphasizes the role that externalities and non-decreasing returns to scale play in the growth process - does not envisage the only conceivable result as being income convergence between rich and poor regions (Chatterji, 1998). It would appear from the "new economic geography" that regional integration might cause more inequality between regions. It is interesting that the possibility of income divergence, despite the fact that it is not necessary, in these models points to a significant change of approach of economic theory on these matters. In a way, the picture these days is similar to that found in the uneven development literature (Kaldor, 1957; and Myrdal, 1957) of the 1950s and 1960s, which was later followed by the neoclassical growth model.

Endogenous growth and "new economic geography" models question the hopeful outlook of the neoclassical model, as far as convergence is concerned. For example, as the Lucas (1988) story shows, if long term growth is encouraged by the endogenous accumulation of practical experience without decreasing returns over a length of time, trade between regions can mean that one region specializes in industries with a particular advantage (e.g. traditional economic activities), but which offers few opportunities for learning, so that the region might have a lower growth rate, due to trade integration.

A "core-periphery" structure might appear with trade integration according to the "new economic geography" literature headed by Krugman (1991a and 1991b). It is suggested that a result of the reduction in transaction costs could be the spatial concentration of increasing returns to scale industries in the centre of Europe, whilst the periphery would concentrate on constant returns to scale industries (such as, low technology industries and agriculture).

Krugman and Venables (1990) found that the selected spatial unit and the time factor affected the way in which the index of distance from purchasing power and the regional GDP per capita were closely related in a negative manner and altered over time, which is especially important for those making policies.

The welfare loss of specialization in the constant return to scale industries is not obvious and neither is the reason it leads to real income divergence. The decrease in real income and the welfare loss for the poorer region, in the "new economic geography" models, result from the poorer region having to pay transaction costs on the manufacturing sector goods produced in the wealthy region (Martin P., 1998).

According to Faini (1984), regions, which contained elements of both the "new economic geography" and the "new growth" models, were found to have an increasing

divergence of growth rates between them as a result of growing returns in the production of non-traded intermediate inputs.

A model such as that of Martin and Ottaviano (1996), which determined growth and geography together and integrated a "new growth" framework to a "new economic geography" model, allowed an exchange between average growth and regional convergence to appear. A more efficient, but also less equal economic geography which makes possible a pattern of high aggregate growth, can thus go hand in hand with increased regional income inequality.

3. Evidence of convergence and divergence

3.1. Evidence of convergence and divergence in Europe

There is controversy surrounding the statistical assessment of convergence. Mostly what is called into question is the level of convergence, i.e. between regions or between countries. In both instances, the stricter analyses of convergence have centered on economic phenomena, ignoring social and quality of life phenomena (Giannias *et al.*, 1999).

Convergence studies were originally based on cross sections and estimated using Ordinary Least Squares (OLS). Following the seminal paper by Barro (1991), such analyses were carried out for a large set of countries (e.g. Barro and Sala-i-Martin, 1991; Levine and Renelt, 1992) as well as regions. Among others, Armstrong, 1995; Molle and Boeckhout, 1995; Neven and Gouyette, 1995; Fagerberg and Verspagen, 1996; Tondl, 1999 and 2001; Martin, 2000, and Vanhoudt *et al.*, 2000, estimated regional convergence in the European Union (EU) in cross-section models. These studies concluded that convergence between EU regions took place, however, at a fairly slow pace reaching 2-3% in the 1960s and 1970s and slowing down to 1.7% after 1975.

On the other hand, panel data convergence studies using (among others) the least squares dummy variable (LSDV) procedure (Islam, 1995; Cuadrado-Roura *et al.*, 1999; Tondl, 1999; de la Fuente, 2002) found extremely fast convergence rates of up to 20%.

The regional convergence after the war found in a very large number of studies (see above), slowly changed to stability or even divergence in the last twenty years of the twentieth century (Canova and Marcet, 1995; Magrini, 1999; Rodriguez-Pose, 1999; Cuadrado-Roura, 2001; Puga, 2002).

Furthermore, there is mounting evidence of the appearance of convergence clubs (Neven and Gouyette, 1995; Quah, 1996) leading to greater polarization and less economic cohesion across Europe (Lopez-Bazo *et al.*, 1999).

In the EC, regional changes were usually slower than those apparent in the U.S. (Neven and Gouyette, 1995). However, the speed of convergence varied greatly between countries, regions and periods even over long periods (Martin P., 1998). Sala-i-Martin (1996) claimed that in the U.S., between 1880 and 1990, the speed of convergence was 1.7%; for European regions the rate was 1.5% between 1950 and 1990. In European countries, on the other hand, the speed varied greatly: 1.6% for French regions, 3% for British regions, 1.4% for German regions, 2.3% for Spanish regions and 1% for Italian regions. Interestingly, according to Martin P. (1998, p. 769), between 1978 and 1992 no convergence between regions within countries was to be found and the convergence rate fell to 1.3% for European regions.

The main problem is that, over the period 1965-1995, the process of regional economic development has shown the existence of both divergence and convergence trends at regional level (Molle and Boeckhout, 1995). As a result, some refer to

consecutive periods of divergence and convergence (see, for example, Barro and Sala-i-Martin, 1991). On the other hand, others have chosen to explain the tendencies with the use of a framework which recognizes the likelihood of simultaneous processes of convergence and divergence in different regions (comparatively) over similar time periods (Boltho and Holtham, 1992; Dunford, 1993; Dunford and Hudson, 1996).

Terrasi (2002) tried to evaluate the main results reached in the rich literature that has flourished on the theme of European regional convergence in recent years, with the purpose to establish whether a consolidated knowledge of the problem has been reached. The conclusion is that while some points have been clarified, others remain still confusing due to the different methods of analysis, periods of time, groups of countries and regional units that have been used.

It is clear that more theoretical and empirical work is needed to comprehend the mechanisms of convergence and divergence at different spatial levels.

3.2. The North-South and the centre-periphery divergence in the EU

GDP measures can be of use for the growing differences between north-western and southern regions, in spite of the fact that these measures are not totally reliable (particularly in Southern Europe, where a growing role is played by the informal economy, mostly during times of economic crisis).

For the period 1975-90, Neven and Gouyette (1995) examined convergence in output per head across regions in the EC. They said the indications were that the difference between the north and the south of the EC was probably more significant when analyzing growth patterns than the difference between the centre and the periphery. A first look at the studies on migration suggests that the population of the southern regions reacts much more slowly to wage and unemployment differences. Perhaps this is one reason why southern regions have not converged after 1985. At the other end of Europe, in the North, the regions had a tendency to remain stationary or diverge at the beginning of the eighties, but converge strongly afterwards.

Graham and Hart (1999), noted that the main core-periphery spatial structures which characterized the EU in the 1990s were very similar to those recognized more than 25 years ago at the time of the first enlargement in 1973, in spite of a more complex map of regional inequality.

It can be said that the north and south of Europe had been exposed to different shocks in the mid-eighties and that as a result of a negative shock the southern regions had moved off the transition path. Trade liberalization (see Single European Market) might result in uneven patterns across regions, where strong scale and agglomeration economies were present, damaging southern regions (Krugman and Venables, 1990; Neven and Gouyette, 1995).

The periphery of Europe now includes large parts of Western France, England, Northern and Eastern Germany, and Denmark, as opposed to the old definition of the Mediterranean countries and Ireland. Moreover, within each of the member states spatial polarization can be seen. This means that high level, high-status jobs are centred in metropolitan areas (e.g. Barcelona, Paris and Dublin) around Europe's "core", whilst peripheral areas manage with only low-level jobs (Graham and Hart, 1999).

It is noteworthy that not only were strong regional economies growing stronger and weaker ones growing weaker, but that "new" growth regions were appearing which made the spatial structure even more complicated; examples of this are Friuli Venezia-Giulia and Lazio in Italy. On the whole, then, in general one may conclude that convergence at the broad EU level has been going on, perhaps slowly, whilst, at the

same time, at regional level wide variations in economic and social well-being are still in existence (Armstrong, 1995).

It is very hard to analyze the progress towards greater social and economic cohesion within the EU, especially in view of the fact that the process of integration creates tensions of political economy. As MacKay (1995, p. 230) stated: "There is a danger that any single group, including economists, will redefine the problems in such a way that the debate does not address the questions that trouble those intimately involved".

However, one should not forget that the assessment of EU regional policy has only been considered significant recently. Therefore, the 1994-99 period was likely to be the first programming cycle to come in for a complete evaluation (Bachtler and Michie, 1995).

4. The ec structural funds and the cohesion fund

The European Social Fund (ESF-1958), the European Agriculture Guidance and Guarantee Fund (EAGGF) with separate guarantee and guidance sections and the European Regional Development Fund (ERDF-1975) are the three main Funds of the EC. ESF, ERDF and the EAGGF-Guidance (1964) are commonly grouped together as the 'Structural Funds' and their target is the economic and social cohesion of the member states. The FIFG (Financial Instrument for Fisheries Guidance), which assists in the restructuring of the fisheries sector, was added to the three traditional Structural Funds (ESF, ERDF, EAGGF-Guidance), in 1993 - (Shackleton, 1993). The EC Structural Funds have been reformed in 1988, 1993, 1999 and 2006 targeting always administrative improvements in the domains of additionality (evidence of added value), partnership (collaboration with regional and local actors), subsidiarity (complementarity of the responsibilities between the various social agencies – namely the responsibility is undertaken by the smallest possible administrative or geographical unit), programming, monitoring and assessment.

Also, the Cohesion Fund (1993), which is a macroeconomic adjustment Fund, provides financial contribution to projects in the fields of environment and trans-European networks in the area of transport infrastructure, in countries with a per capita GDP less than 90% of the EU average (CEC, 1997).

Despite the fact that since 1993 the Structural Funds' relative size has grown at much slower rate and was set to decline until 2006 (CEC, 2001), the money available for development has continued to increase in absolute terms (*Table 1*):

Table 1. **Community expenditure**

Community expenditure Percentages of out-turn in payments	**1980**	**1985**	**1989**	**1993**	**1997**	**2001***
EAGGF guarantee section (CAP)	68.6	68.4	57.7	52.4	49.6	46.1
Development funds:	11.0	12.8	18.8	30.7	32.3	33.2
of which: Cohesion Fund	0	0	0	1.2	2.9	2.6
of which: Structural Funds	11.0	12.8	18.8	29.5	29.4	30.6
Other	20.4	18.7	23.5	17.0	18.1	30.7
Community expenditure as % of Community GDP	0.8	0.92	0.94	1.18	1.12	1.09
Expenditure per capita (EUR)	62.7	105.2	129.5	191.1	217.1	255.2
Development funds on EU GDP	0.09	0.12	0.18	0.36	0.36	0.36

(%)						
Structural Funds per capita (EUR 2000 prices)	13.63	21.09	32.21	69.17	75.80	83.40

* Data for 2001 are provisional. Source: Rodriguez-Pose and Fratesi (2004).

The four Cohesion countries (Greece, Ireland, Portugal and Spain) received by far the highest share of the EU development funds as percentage of their GDP in both periods and, moreover, this share was increasing in all four countries in the second programming period 1994-99 (*Table 2*).

Table 2
Scale of Structural Intervention (1989-1999)

	1989-93 in ECU mn	**1994-99 in ECU mn**	**1989-93 in % of GDP**	**1994-99 in % of GDP**
Portugal	1892	2940	3.07	3.98
Greece	1834	2956	2.65	3.67
Ireland	2374	3608	2.66	2.82
Spain	3017	7066	0.75	1.74
Italy	2374	3608	0.27	0.42
Finland		331		0.40
Sweden		261		0.37
UK	1066	2164	0.13	0.25
France	1387	2491	0.14	0.22
Germany	1680	3622	0.13	0.21
Austria		316		0.19
Belgium	173	349	0.11	0.18
Luxemburg	15	17	0.17	0.15
Netherlands	163	436	0.07	0.15
Denmark	86	140	0.08	0.11
EU-12	14666	27024	0.29	0.45
EU-15		27932		0.51

Source: CEC, 1996.

Between 1989 and 1993, in the four Cohesion countries, fixed investment related to expenditure under Structural and Cohesion Funds came to more than 8% of the total capital formation in these countries. The proportion was 5% in Spain, 13.5% in Portugal, 16% in Greece and 17.5% in Ireland. It is expected that the mean ratio should be 14% of the total for the four countries together, for the period 1994-99 (Martin P., 1998).

5. Assessment of the convergence policies in the EU

5.1. The political dimension

Structural Funds' philosophy was always to develop guidelines and they are not connected with the whole EC social policy. Today, in comparison with the past, it is more difficult to receive financial aid from the ESF; involved agencies must define very clearly what exactly they want and be clearly within the six (now three) Objectives.

There is a clientele oriented to the ESF allocations, namely more specific categories of people (targeting groups) are included at the expense of other categories; so, the Fund becomes less flexible. The latter is also attributable to the concentration of its geographical expansion.

The ERDF has never been sufficient to make a substantial contribution to redressing EC regional imbalances, due to its budgetary inadequacy (Bache, 1999). The Structural Funds represent a small proportion of the overall EC budget (CEC, 1996). The impact of the EC's regional funding was considerably less than that of the regional funding of many member states themselves, although there was a modest increase at EC level (Gudgin, 1998).

On the other hand, the status of the ERDF then in existence, as well as of the Structural Funds as a whole, was unfair, because the contributions (Ardy, 1988; CEC, 1993a) and the funding (Bachtler and Michie, 1999) of the member states were not proportional to their GDP per capita.

Another criticism of the ERDF, which also has to do with the Structural Funds as a whole, is the limited financial aid of the latter to the Objective 2 (declining regions) in all four reforms (very high percentages of funding in Objective 1 areas - see CEC, 1990; CEC, 1993b; CEC, 1999a; Giordano, 2006). Many people have criticized the threshold of 75%, because certain regions marginally above this threshold are also excluded, although they need financial aid [like i.e. South Yorkshire and South Wales in Britain which are granted Objective 1 (less developed regions) status only since 2000 - Eurostat, 2001].

The present function of the Structural Funds has received many criticisms also because all countries contribute to their budget, whereas it would be fairer according to the supporters of this view to transfer money only from the rich, e.g. German, regions to the Portuguese, Spanish or Greek regions.

Criticisms of the rules of the first (1988) and second (1993) reforms of Structural Funds also stress the fact that the member states decided which investments would be financed by the EU, without proper Community control (lack of monitoring and assessment) and this led to the increase of consumption instead of investment, corruption, etc. A big problem was the location of responsibility for the various development projects; it was not clear if the responsible body was the Commission or the national government (Mitsos, 1999).

Horizontal and vertical co-ordination was difficult to meet both technically and politically. Horizontal co-ordination implies that the regional policy would cease to be mainly the concern of a Directorate-General (DG), and become the resultant of common policies. Vertical co-ordination means better co-operation between the Commission departments, governments and the tiers of local government (Lander, regions, local authorities). Each DG in Brussels tends to represent particular lobbies and there was a fragmentation between DGs e.g. DG AGRI promotes agricultural interests. In all Structural Funds, the EC policy process was more or less embryonic and in none was there a clear framework of common goals and values. There were filters which continuously separated Community and national officials (Mitsos, 1994).

In centralized states, like Greece and Portugal, the central governments discussed the eligible projects for finance directly with the EU officials cutting out the regional authorities and the local experts. Given the fact that local governments know better the problems in their areas, this often led to mediocre quality projects and waste of money allocations and deadlines not being met as the evidence shows. However, the involvement of local and regional actors in the policy process during the CSF-3 (2000-06) does not appear to have better results, at least in Greece, in comparison to the past (author's personal experience).

Receipts went directly to the governments, and the clients of the Funds (with the exception of ESF allocations for non-governmental bodies and part of the ERDF infrastructure programme) did not actually receive Community cash in hand (Wishlade, 1999).

In the late 1980s there was an increase in the number of national experts (not EU officials) in Brussels in order to promote the issues of scientific analysis of the projects and co-ordinate better the agencies involved in the complex procedures of the Community's functions. However, the results were not satisfying, because these national experts were influenced more by their own country's interests than by the Commissioners (Mitsos, 1994).

Current budgetary difficulties - following the accession of ten new member states in May 2004 - present a dilemma to the Community; countries are unwilling to concede further budgetary powers or to reform existing policies because of entrenched interests and the unfairness of the present system; yet without further revenue these problems cannot be solved. Furthermore, the territorial concentration in core countries and regions of the benefits of other European policies - and especially of the Common Agricultural Policy (CAP) which represents almost half of the European budget (CEC, 2001, p. 84; de la Fuente and Domenech, 2001, p. 323) - may further dilute the impact of development policies.

The Single European Act exclusively refers to economic topics and competition issues in general, whereas it contains little explicit reference to the social and spatial implications of the Single Market. The Maastricht Treaty (in force since 1993) itself pays little attention to non-economic, non-competition issues in general and to urban and regional issues in particular. Guided by competitive global challenges, EU policies are designed for big industry, banks and large agro-producers, leaving small and medium enterprises (SMEs) and other small-scale productive activities to the Structural Funds (Hadjimichalis, 1994).

Within the Lisbon Agenda (2005), regional policy has been given an important part to play across Europe. In spite of this, the idea of regional policy and its agents are obviously being pressurized. Due to increasing neo-liberal tendencies, all kinds of state aid that could interfere with market forces running their natural course are greatly reduced, while government budgets are suffering cuts. Of late, worldwide political and social developments have led to a change in policy priorities and this has also been influential. Future consensus concerning the aims and objectives of EU regional policy might be threatened by the increasing tendency towards the weakening of interstate solidarity.

5.2. The economic/administrative dimension

Attempts by the EU to encourage convergence through the Structural Funds and the Cohesion Fund can just serve to augment other factors. They need to go hand in hand with national policies in order to create conditions conducive to investment and human capital formation (The Sapir Group, 2005).

In spite of the huge amount of public aids to poor regions, relative movements in the distribution of income, labour productivity and employment rates across European regions show no positive relation with the distribution of the Structural Funds. Specifically, widening employment gaps and a growing positive correlation between productivity levels and employment rates are brought to light. Furthermore, although the distribution of Funds committed by the Commission appears to conform to equity and cohesion principles, once the total cost of projects - which includes the contribution of national authorities - is considered, the image of equity is blurred. This

bias in the allocation process may have contributed to the scarce efficiency of EU regional policy carried out during the nineties (Basile *et al.*, 2002).

Allocations are subject to frequent adjustments to the cash ceilings at the beginning of the financial year, a factor inimical to their use (as the Commission intends) in order to influence long-term economic developments. One consequence is that EU expenditure tends perforce to sustain the previously established policies of individual member states, because of the pressure to utilise payment appropriations within the current financial year.

There are several doubts whether the model of regional development which has come to dominate EC regional policy, namely the potential for 'growth from below' (a Europe of many self-regenerating regional economies), is able to give substantial solutions to the Community as a whole. Regarding the indigenous (small firm based) growth for the vast majority of less affluent regions, research has shown that the build-up of a critical mass of new small firms in regions in which such an entrepreneurial tradition is weak is a very costly and time-consuming exercise, offering only limited short- to medium-term rewards (Storey, 1982; Storey and Johnson, 1987). Furthermore, the internal market is much more likely to work to the advantage of more efficient firms in the advanced regions by fostering the formation of greater agglomeration economics in the core (as mentioned before) and leading to the concentration of high value-added scale-intensive activities in a few regions, as well as reduce the build-up of new entrepreneurship in the least favored regions (Begg, 1989a and 1989b; Williams *et al.*, 1991; Brulhart and Torstensson, 1996; Midelfart-Knarvik *et al*., 2000). The periphery thus becomes increasingly specialized in low value-added manufacturing and non market-oriented services.

Moreover, it has been argued that the excessive concentration placed on competitiveness, in a world of increasing globalization, is leading to increased socio-economic inequalities and unacceptable levels of unaccountable power in multinational corporations (Hadjimichalis, 1994; Krugman, 1996a and 1996b).

The Commission's White Paper on growth, competitiveness and employment (CEC, 1993c), among other issues, stressed the need to foster regional competitiveness. According to Krugman's argument, the outcome of this win-lose type of thinking on regional competitiveness will lead to a clear conflict with the objectives and actions of the Cohesion project. In short, the three trajectories of economic globalization, regionalization and real convergence may well be at odds with each other.

While total EU regional policy expenditures were highest in peripheral areas, EU expenditures in support of the productive sector were much more evenly spread across peripheral and lagging regions of the EU. National regional incentives contributed further to an equalization of support levels across large parts of the Union. European and national productive sector supported thus work at cross purposes and were unlikely to contribute to regional convergence (Martin R., 1998). It has been argued by Midelfart-Knarvik and Overman (2002) that national policies aimed at the protection of certain strategic firms or industrial sectors can provoke distortions which in some cases may contribute to counter the cohesive effects of European development policies.

Furthermore, a study of the effects of the development of the trans-European high speed rail network suggests that the trans-European networks (TENs), despite the claims of the Maastricht Treaty to the contrary, might broaden rather than narrow differences in accessibility between central and peripheral regions (Vickerman *et al.*, 1999).

The reduced pace of regional convergence in Europe can also be explained by the fairly low migration across European regions and the slowing down in the change from agricultural to non-agricultural jobs (Cuadrado-Roura *et al.*, 2000).

Harmonization of taxes and action against anti-competitive measures by national governments will further severely constrain the operation of regional policies. As the MacDougall Report argued 28 years ago, the neglect of a system of fiscal transfer at the EU scale – an issue not yet resolved – could well retard or even terminally compromise the project of integration itself (CEC, 1977).

It is surprising that there is no economic calculation about the 'road' to European economic and monetary union; no-one knows its cost and an analytical estimation was never carried out (Mitsos, 1999). No sensible appraisal can be made of the delivery of the Community policies, their cost-effectiveness or their impact on economic development, though some questions had been raised by the Court of Auditors (1981) in several cases, as well as by the DG for Economic and Financial Affairs (CEC, 5654/92, annex), whereas further research has been undertaken since mid 1990s by Pereira (1994), Bradley *et al.* (1995), Christodoulakis and Kalyvitis (1995), Beutel (1996), Cordero (1996), Roerer (1996) – in the context of the Sixth Regular Report on EC Regions (CEC, 1999b) where they are incorporated, as well as in the 10th Annual Report of Structural Funds (CEC, 1998).

The 1960s and 1970s were characterised by active regional policies aimed at drawing industries to less rich regions by means of subsidies. However, these European government policies were later to be queried in terms of their high cost and ability to produce results (Martin P., 1998). Although at the national level the evaluation of regional policies did not come up to expectations, at the European level regional policies in the 1980s were attracting attention again (Martin P., 1998). Now, in comparison to the 1988 reform, every EU country conducted regular evaluations of regional policy (Bachtler and Michie, 1997).

However, as mentioned before, there are still big discrepancies between EU regions [in 2001, in the 48 Objective 1 regions GDP per capita was 64.86% of the EU-15 average (= 100), whereas 88.07% had the 87 regions with a GDP per head more than 75% but less than the EU mean and 121.78% the 71 regions with a GDP per head more than the EU mean; in the above three regional groups the corresponding figures for productivity were 73.74%, 94.85% and 111.37%, whereas for employment rate were 84.64%, 95.86% and 110.53% - Gardiner *et al.*, 2004]**,** whilst nominal convergence (inflation, interest rates, public and budget deficits) does not lead to a real convergence as, initially, it was believed it would. In any case, seventeen years (1989-2005) is probably a short period for the impact to become apparent. The desired results could perhaps appear much later, since the structural change required is a long-term process.

Furthermore, without evidence of convergence of the 'real economies' of member states, as documented by increased output and employment growth, productivity and falling unemployment rates, fears exist that monetary union could exacerbate the problems of weak regions in the EU-15 (Baddeley *et al.*, 1998). Arguably, the nature and scale of the shock produced by monetary union, and the continuation of tight fiscal policy through the Growth and Stability Pact agreed in Amsterdam in 1997, could increase regional unemployment disparities by exposing the weaker regions to greater levels of deregulation and flexibility.

With respect to methodological approach, the experience of the 1988-93 programming period and the 1993-94 planning period was that the quality and sophistication of evaluation studies have varied greatly, and comparability between CSFs and Operational Programmes (OPs) was highly problematic. This also reflects major conceptual and methodological problems such as insufficiently precise

objectives, inadequate data and difficulties in identifying causality and the counterfactual. Structural Fund operations were evaluated at a variety of levels – project evaluation, programme evaluation, CSF evaluation – which require different approaches and they were difficult to reconcile (Bachtler and Michie, 1997).

The European Commission makes use of the International Labor Office (ILO) definition accrued by the European Labor Force Survey (ELFS) concerning the problem of data at regional level. Despite the fact that internationally accepted questions are asked by the LFS, internationally accepted answers are not forthcoming. The answers are clearly affected by different social security systems in each nation (Fothergill, 1997).

Regarding the Community Initiatives in their entirety, they showed a certain degree of success in reaching their goals of fostering policy innovation and experimentation, also functioning as a significant tool for trans-national co-operation. Because there was a trend in some instances to duplicate interventions existing in the core programmes, a clear added value was not always achievable (Hall, 1997). As a result, the 1999 revision narrowed their influence to four areas, where the added value is easier to be achieved.

Regarding the impact of the training programmes on the labour market, it is still highly questionable if they help match the supply to the demand for labour, given the persistence of high unemployment rates among the EU member states and regions, even during periods of rapid economic growth.

Moreover, the EU enlargement would probably create serious problems, as almost all the initial 15 member states could become net contributors to the regional and social budgets, and perhaps to the EU budget as a whole. This would bring huge obstacles to the Southern European manpower to adapt to the labor market needs; this is one of the main reasons that the human resources (and training in particular) will increase its EU funding share in the CSF-4 (2007-2013).

Finally, concerning the Integrated Mediterranean Programmes (IMPs) - the execution of all of them has finished in 1994 - transparency appeared in principle to be satisfied (Yannopoulos, 1989). But again in practice there were difficulties in establishing how far a particular form of spending would exclusively be channelled to the pursuit of the specific objectives of the IMPs (Plaskovitis, 1994).

6. Concluding remarks

Despite the fact that the effect of Community regional policy was negligible throughout the 1960s, 1970s and 1980s, between 1988 and 2004 EC regional policy set in motion a large quantity of resources and accomplished a greater efficiency in its interventions by means of partnership, focusing on certain objectives, multi-annual programming, synthesis of loans and subsidies, etc. Administrative processes were finer tuned following the 1993 and 1999 revisions. Nevertheless, alterations to the guidelines for the future will result from the continuing lack of development in a number of regions, the demands connected to integration, the expansion in May 2004 with ten CEE/SEE nations and the experience acquired in the first years of the new regional policy.

The nations receiving funding relied on this aid from Brussels (usually up to 70-75% of the total cost of each project) to enable them to pay for the majority of public works in their areas, as a number of projects and other works of great significance for their economic and social advance could not be paid for by their own resources.

Between 1989 and 2004 there was a notable rise in the evaluation of regional policy. As opposed to the situation at the beginning of the 1980s, each EU nation now

carries out periodic evaluations of regional policy. This also shows the European Commission's concern with assessment and the pressure on member states to evaluate the effect of EU regional funding, which was spelled out in the reform of the Structural Funds in 1999.

Regional and social policies are the most significant policies instigated by the EU to make for better redistribution of wealth. The way these are done expresses the EU's desire to make the policies contribute to the efficiency regarding distribution. In the EU the aim of social policy is mainly restricted to a re-allocation of funds through the ESF for workers of depressed areas to be retrained or for the unemployed. It is unclear what the impact of the ERDF on the reduction in the regional inequalities is. The impact of European integration generally is not well documented.

The question of whether the EU has aided the reduction in inequality in national wealth and causes inequality in regional wealth is still under discussion, but it would seem that the EU has accomplished this aim to a certain degree (Ireland is an extreme instance, but monetary support from the Community is just one factor leading to the fast economic growth in Ireland). Assessments of the impacts of both the regional and social policies are quite critical. Despite the fact that the redistribution impact in budgetary terms is definite, the effect on growth and efficiency is restricted since 43 of the original 44 regions eligible for Objective 1 in 1989 were still there 16 years after the reform (Rodriguez-Pose and Fratesi, 2004). It should not be forgotten that from 1989-2002 the Cohesion nations grew more quickly than even the USA (Dunford, 2005), whilst Ireland (from the early 1990s onwards) and Greece (from 2000 onwards) have the highest average GDP growth in the EU-15 (Eurostat). Furthermore, it is noteworthy that according to the official data of Eurostat which will be released by the autumn 2007, following the revision of the Greek GDP by the Greek authorities by about 26% (ECOFIN, 5 June 2007), Greek GDP per capita is between 100-101% of the EU mean. For this reason Greece not only will contribute retrospectively to the Community budget from 1994, but Greece's payments to the EU budget will be higher than it was until today from now onwards.

At the same time as the European Commission is correctly showing particular interest in the productive performance and competitiveness of the EU and its regions, and the integration of the new enlargement states into the Union, it would appear that the role, effectiveness and funding of regional policy are being subjected to a more critical appraisal and re-evaluation (e.g. Boldrin and Canova, 2001; Puga, 2002; Sapir *et al.*, 2003; Gardiner *et al.*, 2004).

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Testing Technical Anomalies in Athens Stock Exchange (ASE)

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Abstract

The purpose of this paper is to investigate the existence of historical Market anomalies in the Athens Stock Market (ASE). The market anomalies that are going to be explored are technical ones concerning the trading rules of the various types of moving averages.

The above anomalies were observed in most developed and developing markets. This study will investigate these effects for the most important index of the Athens market, the Athens General Index. The data used are for the period from 1/1/1990 to 31/12/2004. Overall, our results confirm the existence of technical anomalies in ASE and provide strong support for profitability of those technical trading rules.

Keywords: Stock markets, technical anomalies, bootstrap.

JEL classification: G12, G15.

1. Introduction

Basic aim of this paper is to investigate the existence of market anomalies in the Athens Exchange Market and particularly for the General Index of ASE (Athens Stock Exchange). The market anomalies that are going to be explored are technical anomalies concerning the trading rules of the simple moving average and the exponential moving average.

Technical Analysis is the study of prices with charts being the primary tool to make better investments. Otherwise, technical analysis tests historical data attempting to establish specific rules for buying and selling securities with the objective of maximising profits and minimising risk of loss. Basic idea of technical analysis is to forecast the equity prices examining past prices.

Technical anomalies were observed in most developed and developing markets. Although many earlier studies concluded that technical analysis is useless, the recent studies on predictability of equity returns from past returns suggest that this conclusion might have been premature. This paper will sum up these anomalies that seem to contradict with the evidences that the stock markets are highly efficient. It is the

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Efficient Market Hypothesis and random walk theory versus practice. This study will investigate technical anomalies for the most important index of the Athens market, the Athens General Index. The Athens General Index is the most famous index of the Athens Exchange.

In this paper, we explore two of the simplest and most popular technical rules: simple moving averages and the exponential moving averages. These rules will be evaluated by their ability to forecast future price changes. The methodology that is going to be used for the analysis of the data is standard tests (t-test), which was used in the past in numerous studies for the investigation of technical anomalies. The t-test is used in order to assess if the means of two data groups are statistically different from each other in order to compare these means. The t-test formula is a ratio. In addition, standard tests will be compared with the bootstrap methodology inspired by Efron (1979), and Efron and Tibshirani (1986). Bootstrapping is a method, introduced by Efron (1979), for estimating the distributions of statistics that are otherwise difficult or impossible to determine. The general idea behind the bootstrap is to use resampling to estimate an empirical distribution for the statistic. Artificial samples are drawn from the original data, being the statistic of interest recalculated based on each artificial sample. The resulting "bootstrapped" measures are then used to construct a sampling distribution for the statistic of interest. Following this methodology, returns from an artificial Athens Stock Exchange series are generated and the trading rules are applied to the series. Comparisons are then made between returns from these simulated series and the actual Athens Stock Exchange series.

In this paper there will be an investigation of the time periods from 1990 to 2004. The period 1990 - 2004 is a very important investigation period for the Athens Stock Exchange as there are no studies for that period, the Athens Stock exchange has become a developed market, Greece has adopted the euro currency and a successful derivatives market in introduced. In Greece there were no investigations concerning the technical anomalies. The majority of stock market professionals worldwide and in Athens Exchange use technical analysis. The moving average rule gives entry signals in the case the moving average of the short period penetrates the moving average of the long period. The short signal is given when the long period moving average penetrates the short period moving average.

In section 2 we see the literature review. This chapter refers to the available knowledge that is related to the topic of investigation. Section 3 describes the data and technical trading rules used. Section 4 reports the methodology of the paper. In section 4 we see the outcomes and findings of the research (standard statistical & empirical results from the bootstrap simulations). Finally, in section 5 the outcome and the concluding remarks of the research are stated and summarized.

2. Literature Review

Fama and French (1988) in tests for the 1926 to 1985 period examined autocorrelations of daily and weekly stock returns. They found significant statistical serial correlation in price series of small and large firm portfolios of all New York Stock Exchange stocks, over various time horizons. Their state"Our results add to mounting evidence that stock returns are predictable". They estimated that 25-45% of the variation of 3-5 year stock returns is predictable.

Neftci (1991) studied the usefulness of the well-defined rules of technical analysis are useful in prediction. The first of the two interests of the study were to devise formal algorithms to represent various forms of technical analysis and see if

these rules are well defined. The second interest was to discuss the conditions that technical analysis can capture properties of stock prices by linear models of Wiener-Kolmogorov prediction theory. The author concludes, "Tests done using Dow-Jones industrials for 1911-76 suggested that this may indeed be the case for the moving average".

Brock William, Lakonishok Josef, LeBaron Blake (1992), also known as (BLL), tested two of the simplest and most popular trading rules--moving average and trading range break--by utilizing the Dow Jones Index from 1897 to 1986. Standard statistical analysis is extended using bootstrap techniques. Overall, their results provide strong support for the technical strategies. The returns obtained from these strategies are not consistent with four popular null models: the random walk, the AR(1), the GARCH-M, and the Exponential GARCH. Buy signals consistently generate higher returns than sell signals, and further, the returns following buy signals are less volatile than returns following sell signals. Moreover, returns following sell signals are negative, which is not easily explained by any of the currently existing equilibrium models.

Balsara Nauzer, Carlson Kathleen and Narendar V. Rao, (1996), studied the behaviour of a fixed-parameter technical trading rule as applied to four commodity futures contracts. They used the dual moving average crossover rule to generate buy and sell signals. The evidence suggests that fixed-parameter rules are inflexible, leading to wide swings in performance both across commodities and across periods. They concluded, "These findings have powerful practical implications, in as much as they recommend that traders be wary about using fixed-parameter mechanical trading systems. Instead of expecting the market to adapt to a fixed, time-invariant set of rules, a mechanical system should be flexible in nature, adjusting its parameters dynamically in response to changes in market conditions as soon as they occur. Flexible systems are the key to success in any technical trading program in the futures market."

Rodríguez, Sosvilla and Andrada (1999) in their paper judge whether some simple forms of technical analysis as Variable Moving Average, Fixed Moving Average and Trading Range Break out can predict stock price movements in the Madrid Stock Exchange. Their study covered the period from January 1966 to October 1997. They used the daily data of the General Index of the Madrid Stock Exchange and the bootstrap methodology. They state, "Our results provide strong support for profitability of these technical trading rules."

Ki-Yeol Kwon and Richard J. Kish (2002) investigated an empirical analysis on technical trading rules (the simple price moving average, the momentum, and trading volume) utilizing the NYSE value-weighted index over the period 1962-1996. The methodologies employed include the traditional *t*-test and residual bootstrap methodology utilizing random walk, GARCH-M and GARCH-M with some instrument variables. The results indicate that the technical trading rules add a value to capture profit opportunities over a buy-hold strategy.

Wing-Keung Wong, Meher Manzur, Boon-Kiat Chew (2003) focuses on the role of technical analysis in signalling the timing of stock market entry and exit. Test statistics are introduced to test the performance of the most established of the trend followers, the Moving Average, and the most frequently used counter-trend indicator, the Relative Strength Index. Using Singapore data, the results indicate that the indicators can be used to generate significantly positive return. It is found that member firms of Singapore Stock Exchange (SES) tend to enjoy substantial profits by applying technical indicators.

Atmeh M. and Dobbs I.M., (2004) investigated the performance of moving average rule in the Jordanian stock market. The returns from trading strategies based on

various moving average rules are examined. The results show that technical trading rules can help to predict market movements, and that there is some evidence that (short) rules may be profitable after allowing for transactions costs, although there are some caveats on this. Sensitivity analysis of the impact of transaction costs is conducted and standard statistical testing is extended using bootstrap techniques. The conditional returns on buy or sell signals from actual data are compared to the conditional returns from simulated series generated by a range of models (random walk with a drift, AR (1), and GARCH-(M)) and the consistency of the general index series with these processes is then examined.

3. Data and technical trading rules

In this study, we use data series for the General Index of Athens Stock Exchange from the 1/1/1990 to 31/12/2004. The database used is composed of 3734 observations. The Athens General Index is the most famous index of the Athens Exchange. The Athens General Index constituted from the 60 stocks of the Athens Exchange with the largest capitalization.

Moving averages are one of the oldest and most popular technical analysis tools. A Moving Average is an indicator that shows the average value of a security's price over a period of time. When calculating a moving average, you specify the time span to calculate the average price. According to the moving average rule, buy and sell signals are generated by two moving averages of the level of the index: a long-period average and a short-period average. A typical moving average trading rule prescribes a buy (sell) when the short-period moving average crosses the long-period moving average from below (above). The idea behind computing moving averages it to smooth out an otherwise volatile series. As can be seen, the moving average rule is essentially a trend following system because when prices are rising (falling), the short-period average tends to have larger (lower) values than the long-period average, signalling a long (short) position.

The only significant difference between the various types of moving averages is the weight assigned to the most recent data. Simple moving averages apply equal weight to the prices. Exponential and weighted averages apply more weight to recent prices.

The critical element in a moving average is the number of time periods used in calculating the average. The most popular moving average is the 30-day moving average. This moving average has an excellent track record in timing the major market cycles. These moving averages are used in this paper, as they are the most common in used by the chartists-technical analysts.

Adding the closing price of the security for a number of time periods and then dividing this total by the number of time periods calculates a simple moving average. The result is the average price of the security over the time period. Simple moving averages give equal weight to each daily price.

An exponential moving average is calculated by applying a percentage of today's closing price to yesterday's moving average value. Exponential moving averages place more weight on recent prices.

We evaluate the following popular moving average rules: 1-9, 1-15, 1-30, 1-50 and 1-90, where the first number in each pair indicates the days in the short period and the second number shows the days in the long period.

All transactions assume 0.18% (of the investing capital) commission as entry (buy) fees and 0.31% (of the investing capital) as exit (sell) fee. Those fees are usual fort institutional investors or securities firms participate in these transactions.

4. Methodology

In this section, there is a description of the research objective of this project and the rationale behind it. The research objective of this project is to investigate the existence of technical anomalies in the Athens exchange market.

The technical anomalies that are going to be investigated are simple moving averages and exponential moving averages. The investigation of these moving averages will be achieved by comparing the returns given by the buy (long position) signals of the moving average with the returns of the buy and hold method. Furthermore, the returns given by the buy signals of the moving average minus the returns of the sell signals of the moving average with the returns of the buy and hold method will be compared. The hypothesis that the returns of the buy and hold method with the returns of the moving average method will be examined using the t-test methodology. The moving averages give buy signal when the short term moving average crossover the long-term moving average. On the other side, we have a sell signal when the long term moving average crossover the short-term moving average.

Before the investigation of the technical anomalies, using the t-test, descriptive statistics will be used. The use of descriptive statistics is a common first step in order to summarize, organize and describe the information of the data, in this case the returns of the indices. A way to measure the central tendency of the information is by calculating the mean return. The mean return is calculated adding the daily returns of an index, for a period, dividing the sum by the total number of observations for that period.

As we told the methodology that is going to be used for the analysis of the data is t-test, which was used in the past in numerous studies for the investigation of technical anomalies. The t-test is used in order to assess if the means of two data groups are statistically different from each other in order to compare these means. The t-test formula is a ratio.

The t-statistic is calculated by the formula:

$$t = \frac{\overline{R_1} - \overline{R_2}}{\sqrt{\left(\frac{SD_1^2}{N_1} + \frac{SD_2^2}{N_2}\right)}}$$

Where the:

SD_1 is the square root of the variance of the returns of the case 1.

SD_2 is the square root of the variance of the returns of the case 2.

N_1 is the number of measurements considered of the case 1.
N_2 is the number of measurements considered of the case 2.
$\overline{R}_1$ is the mean daily returns of the index of the case 1.
$\overline{R}_2$ is the mean daily returns of the index of the case 2.

Finally, the t-test will be used in the moving average case. Using t-test will compare the mean returns of the unconditional buy methodology with the returns of the buy signals given by the moving averages and the returns of the unconditional buy methodology with the returns of the buy signals minus the returns of the sell signals given by the moving averages.

The results of the t-test will help to either accept the null hypothesis (there is no actual difference between mean returns) or reject our null hypothesis (there is an actual difference the mean returns). So the two hypotheses for the above test are:

Accept Null Hypothesis: $H_1 : \overline{R}_1 - \overline{R}_2 = 0$

Reject Null Hypothesis: $H_2 : \overline{R}_1 - \overline{R}_2 \neq 0$

All transactions assume 0.18% (of the investing capital) commission as entry (buy) fees and 0.31% (of the investing capital) as exit (sell) fee. Those fees are usual fort institutional investors or securities firms participate in these transactions.

The results presented in t test assume independent, stationary and asymptotically normal distributions. Many times these assumptions certainly do not characterize the returns from the ASE series. Following BLL (1992), this problem can be solved using bootstrap methods (Efron and Tibshiarani, 1993).

Bootstrapping is a method, introduced by Efron (1979), for estimating the distributions of statistics that are otherwise difficult or impossible to determine. The general idea behind the bootstrap is to use resampling to estimate an empirical distribution for the statistic. Artificial samples are drawn from the original data, being the statistic of interest recalculated on the basis of each artificial sample. The resulting "bootstrapped" measures are then used to construct a sampling distribution for the statistic of interest.

The Procedures of the bootstrap method is: creating Z bootstrap samples, each consisting of N observations by sampling with replacement from the original return series. Then we calculate the corresponding price series for each bootstrap sample given that the price next period is

$$P_{t+1} = exp(r_{t+1})P_t$$

After that we apply the trading rule (moving average) to each of the Z pseudo price series. Afterwards, we calculate the performance statistic of interest for each of the pseudo price series. Finally we determine the P-value by calculating the number of times the statistic from the pseudo series exceed the statistic from the original price series. To use the bootstrap method a data generating process (DGP) for market prices or returns must be specified a priori. The bootstrap method can be used to generate many different return series by sampling with replacement from the original return series.

The bootstrap samples created are pseudo return series that retain all the distributional properties of the original series, but are purged of any serial dependence. Each bootstrap sample also has the property that the DGP of prices is a random walk with drift.

$$\ln P_{t+1} = \mu + \ln P_t + \varepsilon_t$$
$$\varepsilon_t \sim IID\ N(0, \sigma^2)$$

Where μ represents the drift in the series, $\ln P$ is the natural logarithm of the price and ε is the stochastic component of the DGP.
To test the significance of the trading rule excess returns the following hypothesis can be stated

$$H_0: \quad XR \leq \bar{XR}^*$$
$$H_1: \quad XR > \bar{XR}^*.$$

Under the null hypothesis, the trading rule excess return (XR) calculated from the original series is less than or equal to the average trading rule return for the pseudo data samples ($\bar{XR}^*$).

The p-values from the bootstrap procedure are then used to determine whether the trading rule excess returns are significantly greater than the average trading rule return given that the true DGP is a random walk with drift.

In order to test our hypothesis we will use the econometric program Matlab 7.0. The bootstrap methodology requires high computer power and computer programming (because there are not any toolboxes for bootstrapping suited for this study).

5. Findings

5.1 Standard statistical results

Table 1 reports some summary statistics for daily returns. Returns are calculated as log differences of the General Index of ASE level. As can be seen, these returns exhibit excessive kurtosis and nonnormality in returns.

Table 1 Statistics for daily returns

num:	3733
max:	0.1375
min:	-0.0962
mean:	0.000482112
median:	-0.000727175
range:	0.2336
std:	0.0176
skewness:	0.2102
kurtosis:	7.8903
jarquebera:	0.000374523
jbpval:	0

Descriptive Statistics for the returns
Jarque-Bera test for Normality
JB-stat p-value
------- ------
0.000374523 0.000000 rejects Normality
Buy-Hold mean return 0.000482112 euro equity

Returns are calculated as log differences of the General Index of ASE level.

If technical analysis does not have any power to forecast price movements, then we should observe that returns on days when the rules emit by signals do not differ appreciably from returns on days when the rules emit sell signals.

In Table 2 we present the results from simple moving average trading strategies. The rules differ by the length of the short and long period. For example (1,50) indicates that the short period is one day, the long period is 50 days. We present results for the 6 rules that we examined. In 3 and 4 columns (table 2) we report the number of buy "N(Buy)" and sell "N(Sell)" signals generated during the period. When we write about buy we discuss for long position [we begin the transaction with buy position and then we sell – we follow long position in (bull) up-trend market]. On the other hand when we write about sell we discuss for short position [we begin the transaction with sell position and then we buy – we follow short position in (bear) down-trend market]. The (daily) mean buy and sell returns are reported separately in columns 5 and 6. The last column "Buy-Sell" lists the differences between the mean daily buy and sell returns. The t statistics for the Buy and Sell statistics are computed using the following BLL, 1992 methodology.

Table 2: Standard results for the simple moving rules

Period	Test	N(buy) (Long Strategy)	N(sell) (Short Strategy)	Buy (Long Strategy)	Sell (Short Strategy)	Buy-sell
1/1/90 to 31/12/04	(1,9)	273	272	0.001168	-0.00074	0.001906
	(1,15)	202	201	(2.992496)	(-3.6324)	(6.440012)
	(1,21)	161	160	0.001081	-0.00066	0.001737
	(1,30)	128	127	(2.911536)	(-3.36109)	(6.062579)
	(1,50)	87	86	0.000956	-0.00054	0.001497
	(1,90)	62	61	(2.44205)	(-3.04905)	(5.219619)
	Average			0.00961	-0.00056	0.001521
				(2.43062)	(-3.10043)	(5.305773)
				0.000725	-0.00038	0.001108
				(2.015469)	(-2.58049)	(3.890203)
				0.000576	-0.00032	0.000896
				(1.358212)	(-2.38927)	(3.199685)
				0.000911	-0.000533	0.001444

Notes: N(buy) and N(Sell) are the number of buy and sells signals generated by the rule. Number in parentheses are standard t-statistics testing the difference, respectively, between the mean buy return and the unconditional mean return, the mean sell return and the unconditional mean return, and buy-sell and zero. The last row reports averages across all 6 rules.

As we can see in Table 2, the buy-sell differences are significantly positive for all rules. All the buy-sell differences are positive and the t-tests for these differences are highly significant rejecting the null hypothesis of equality with zero. [For 0.05 probability the upper (lower) critical values of the t-test values are +(-) 1.960]. The mean buy-sell returns (short – long position) are all positive with an average daily return of 0.1444 percent, which is about 36.10 percent at an annual rate (250 trading days x 0.1444%).

We present results for the 6 rules that we examined. The mean buy returns (long position) are all positive with an average daily return of 0.0911 percent, which is about 22.78 percent at an annual rate (250 trading days x 0.0911%). The t-statistics reject the null hypothesis that the returns equal the unconditional returns (0.048 percent from Table 1). Five of the six tests reject the null hypothesis that the returns equal the unconditional returns at the 5 percent significance level using a two-tailed test. The other five tests are significant. For the sells (short position), the average daily return of 0.0533 percent, which is 13.32 percent on an annualised basis. All of the tests reject the null hypothesis that the returns equal the unconditional returns at the 5 percent significance level using a two-tailed test. Under the null hypothesis that technical rules do not produce useful signals the fraction of positive returns should be the same for both buys and sells.

The lowest number of buy signals is for the (1,90) rule which generates an average of 4.43 signals per year over the 14 years of data. Also, the largest number of buy signals is generated by the (1,9) rule with 19.5 signals per year.

The largest number of sell signals is for the (1,9) rule which generates an average of 19.43 signals per year over the 14 years of data. Also, the lowest number of buy signals is generated by the (1,90) rule with 4.36 signals per year

In Table 3 we display the results from exponential moving average trading strategies. The rules differ by the length of the short and long period. We present results for the 6 rules that we examined. In 3 and 4 column (table 2) we report the number of buy "N(Buy)" and sell "N(Sell)" signals generated during the period. The mean buy and sell returns are reported separately in columns 5 and 6. The last column "Buy-Sell" lists the differences between the mean daily buy and sell returns. The t statistics for the Buy and Sell statistics are computed using the following BLL, 1992 methodology.

Table 3: Standard results for the exponential moving rules

Period	Test	N(buy) (Long Strategy)	N(sell) (Short Strategy)	Buy (Long Strategy)	Sell (Short Strategy)	Buy-sell
1/1/90 to 31/12/04	(1,9)	145	144	0.000964	-0.00053	0.001497
	(1,15)	99	98	(2.568305)	(-3.0221)	(5.218606)
	(1,21)	84	83	0.001019	-0.0059	0.001612
	(1,30)	66	65	(2.627126)	(-3.21687)	(5.62262)
	(1,50)	36	35	0.000736	-0.00032	0.001057
	(1,90)	30	29	(2.540766)	(-2.39801)	(3.678029)
	Average			0.000722	-0.00032	0.001041
				(2.398905)	(-2.39088)	(3.625273)
				0.000618	-0.00028	0.000894
				(2.283028)	(-2.27566)	(3.133622)
				0.000307	-0.00005295	0.000360
				(1.45634)	(-1.62567)	(1.28446)
				0.000728	-0.000349	0.0010767

Notes: N(buy) and N(Sell) are the number of buy and sells signals generated by the rule. Number in parentheses are standard t-statistics testing the difference, respectively, between the mean buy return and the unconditional mean return, the mean sell return and the unconditional mean return, and buy-sell and zero. The last row reports averages across all 6 rules.

As we can see in Table 3, the buy-sell differences are significantly positive for all rules. All the buy-sell differences are positive and the t-tests, except one, for these differences are highly significant rejecting the null hypothesis of equality with zero.[For 0.05 probability the upper (lower) critical values of the t-test values are +(-) 1.960]. The mean buy-sell returns (short – long position) are positive with an average daily return of 0.1077 percent, which is about 26.92 percent at an annual rate (250 trading days x 0.1077).

The mean buy returns (long position) are all positive with an average daily return of 0.0728 percent, which is about 18.19 percent at an annual rate (250 trading days x 0.0728%). All except one t-statistics reject the null hypothesis that the returns equal the unconditional returns (0.048 percent from Table 1). For the sells (short position), average

daily return of 0.0349 percent, which is 8.73 percent on an annualised basis. All except one of the tests reject the null hypothesis that the returns equal the unconditional returns at the 5 percent significance level using a two-tailed test.

The lowest number of buy signals is for the (1,90) rule which generates an average of 2.14 signals per year over the 14 years of data. Also, the largest number of buy signals is generated by the (1,9) rule with 10.36 signals per year.

The largest number of sell signals is for the (1,9) rule which generates an average of 10.28 signals per year over the 14 years of data. Also, the lowest number of buy signals is generated by the (1,90) rule with 2.07 signals per year.

If we compare table 2 and table 3 we will see that the mean (buy) returns daily from simple moving averages are higher than mean buy returns from exponential moving averages (0.0911% >0.0728%). Also, the mean (sell) returns daily from simple moving averages are higher than mean sell returns from exponential moving averages (0.0533% >0.0349%). In addition the buy-sell mean returns daily from simple moving averages are higher than returns from exponential moving averages (0.1444% >0.1077%). Possible explanation is that simple moving averages give equal weight to each daily price while exponential moving averages place more weight on recent prices. Besides the last five years we have lived in down trend market. Both of technical strategies "beat" or "win" the market (General Index of Athens Stock Exchange – Buy and hold Strategy). In particular, Buy-Hold Strategy (Table 1) give us 12 % per year (0.048 X 250 days) and using exponential moving averages strategy 26.92 % (buy-sell) at an annual rate and using simple moving averages strategy 36.10 percent (buy-sell) at an annual rate.

a. Bootstrap Results

As we told t test assume normal, stationary, and time-independent distributions. For stock returns there are several well-known deviations from this assumed distribution. As we saw many distributions have positive or negative skewness values, which mean that distributions are skewed right or left. Also most of the distributions have positive Kurtosis values, which indicate that most of the return distributions are leptokurtic. So we further our analysis via the bootstrap methodology under the null model of random walk with drift. Using the bootstrap methodology we enrich our analysis.

Bootstrap methodology inspired by Efron (1982), Freedman (1984), Freedman and Peters (1984a, 1984b), and Efron and Tibshirani (1986).

Following BLL we create 500 bootstrap samples, each consisting of 3734 observations by sampling with replacement from the original return series. Then we calculate the corresponding price series for each bootstrap sample. After that we apply the trading rule (moving averages) to each of the 500 pseudo price series. Afterwards, we calculate the performance statistic of interest for each of the pseudo price series. Finally we determine the P-value by calculating the number of times the statistic from the pseudo series exceed the statistic from the original price series (General Index).

So, each of the simulations is based on 500 replications of the null model (random walk with drift). This should provide a good approximation of the return distribution under the null model. The null hypothesis is rejected if returns obtained from the actual General index of ASE data are greater than the returns of the simulated returns under the null model.

In Table 4 we present the results of random walk simulations using simple moving average trading strategies via bootstrapping. The rules differ by the length of the short and long period. We present results for the 6 rules that we examined. All the

numbers presented in 4, 5, 6 columns are the fractions of the simulated result which are larger than the results for the original General index of Athens Stock Exchange. The mean buy and sell returns are reported separately in columns 4 and 5. Results for returns are presented in the columns 4,5,6 are p-values. The p-values from the bootstrap procedure are then used to determine whether the trading rule excess returns (simple moving averages) are significantly greater than the average trading rule return given from original series. The numbers in parenthesis in 4,5,6 columns show how many series from 500 replications are greater than from original returns. More specifically the number in the column labelled Buy, which is (428), shows that 428 of the simulated random walks generated a mean buy return as large as that from the original General index of Athens Stock Exchange. As we see from reported numbers in 4,5,6 columns most of the simulated random walks were greater than those from the General index of Athens Stock Exchange series. All the buy, sell and buy-sell are highly significant accepting the null hypothesis. Under the null hypothesis, the trading rule excess return (XR) calculated from the original series is less than or equal to the average trading rule return for the pseudo data samples ($\bar{XR}^*$). [For 0.05 probability the p-value must be greater than 0.05 (p-value>0.05). The results for the returns are consistent with the traditional tests presented earlier.

Table 4: Simulation Tests from Random Walk Bootstraps for 500 replications (simple moving rules)

Period	Test	Results	Buy	Sell	Buy-sell
1/1/90 to	(1,9)	Fraction > General Index	0.856	0.824	0.52
31/12/04			(428)	(412)	(260)
	(1,15)	Fraction > General Index	0.874	0.824	0.538
			(437)	(412)	(269)
	(1,21)	Fraction > General Index	0.846	0.872	0.516
			(423)	(436)	(258)
	(1,30)	Fraction > General Index	0.874	0.854	0.546
			(437)	(427)	(273)
	(1,50)	Fraction > General Index	0.862	0.86	0.554
			(431)	(430)	(277)
	(1,90)	Fraction > General Index	0.848	0.846	0.58
			(424)	(423)	(290)
	Average		0.86	0.847	0.542

In Table 5 we present the results of random walk simulations using exponential moving average trading strategies. All the numbers presented in 4,5,6 columns are the fractions of the simulated result which are larger than the results for the original General index of Athens Stock Exchange. Results for returns are presented in the columns 4,5,6 are p-values. The number in parenthesis in 4,5,6 columns show how many series from 500 replications have greater returns than from original returns. All the buy, sell and buy-sell are highly significant accepting the null hypothesis. Under the null hypothesis, the trading rule excess return (XR) calculated from the original series is less than or equal to the average trading rule return for the

pseudo data samples ($\bar{X}^{*}_{R}$). [For 0.05 probability the p-value must be greater than 0.05 (p-value>0.05).
Furthermore, it should be mentioned that the results are consistent with study of BLL (1992).

Table 5: Simulation Tests from Random Walk Bootstraps for 500 replications (exponential moving rules)

Period	Test	Results	Buy	Sell	Buy-sell
1/1/90 to	(1,9)	Fraction > General Index	0.846	0.842	0.512
31/12/04			(423)	(421)	(256)
	(1,15)	Fraction > General Index	0.848	0.856	0.558
			(424)	(428)	(278)
	(1,21)	Fraction > General Index	0.862	0.852	0.572
			(431)	(426)	(286)
	(1,30)	Fraction > General Index	0.872	0.88	0.588
			(436)	(440)	(294)
	(1,50)	Fraction > General Index	0.868	0.866	0.606
			(434)	(433)	(303)
	(1,90)	Fraction > General Index	0.858	0.876	0.64
			(429)	(438)	(320)
	Average		0.859	0.862	0.579

6. Conclusion.

In this paper, we have investigated of the existence of market anomalies in the Athens Exchange Market and particularly for the General Index of ASE (Athens Stock Exchange). The market anomalies that we have explored were technical anomalies (rules of simple moving averages and the exponential moving averages). The moving average rule gives entry signals in the case the moving average of the short period penetrates the moving average of the long period.

The rules of simple moving averages and the exponential moving averages have evaluated for the General Index of the Athens Stock Exchange (ASE), using daily data for the period from 1990 to 2004. This period was a very important investigation period for the Athens Stock Exchange as there are no studies for that period, the Athens Stock exchange has become a developed market, Greece has adopted the euro currency and a successful derivatives market in introduced. In Greece there were no investigations concerning the technical anomalies.

In our analysis, we have used standards tests in combination with bootstrap methods. The bootstrap methodology requires high computer power and computer programming because none econometric program has toolboxes for bootstrapping.

We evaluate the following popular moving averages rules: 1-9, 1-15, 1-30, 1-50 and 1-90, where the first number in each pair indicates the days in the short period and the second number shows the days in the long period. These moving averages are used in this paper, as they are the most common used by the chartists-technical analysts. In order to test our hypothesis we used the econometric program Matlab 7.0. The bootstrap methodology requires high computer power and computer programming (because there

are not any toolboxes for bootstrapping). All transactions assume 0.18% (of the investing capital) commission as entry (buy) fees and 0.31% (of the investing capital) as exit (sell) fee. Those fees are usual fort institutional investors or securities firms participate in these transactions.

For the simple moving averages, trading strategies all the buy-sell differences are positive and the t-tests for these differences are highly significant rejecting the null hypothesis of equality with zero. The mean buy-sell returns (short – long position) are all positive with an average daily return of 0.1444 percent, which is about 36.10 percent at an annual rate. The mean buy returns (long position) are all positive with an average daily return of 0.0911 percent, which is about 22.78 percent at an annual rate. For the sells (short position), the average daily return of 0.0533 percent, this is 13.32 percent on an annualised basis. All of the tests reject the null hypothesis. Under the null hypothesis that technical rules do not produce useful signals the fraction of positive returns should be the same for both buys and sells.

For the exponential moving averages, trading strategies all the buy-sell differences are positive and the t-tests, except one, for these differences are highly significant rejecting the null hypothesis of equality with zero. The mean buy-sell returns (short – long position) are positive with an average daily return of 0.1077 percent, which is about 26.92 percent at an annual rate. The mean buy returns (long position) are all positive with an average daily return of 0.0728 percent, which is about 18.19 percent at an annual rate. For the sells (short position), average daily return of 0.0349 percent, this responds to 8.73 percent on an annualised basis.

Furthermore, both of technical strategies "beat" the market (General Index of Athens Stock Exchange – Buy and hold Strategy). In particular, Buy-Hold Strategy give us 12 % annually returns (0.048 X 250 days) and using exponential moving averages strategy 26.92 % (buy-sell) (at an annual rate) and using simple moving averages strategy 36.10 percent (buy-sell) at an annual rate.

These results seem to contradict with the Efficient Market hypothesis as the investors can gain abnormal returns investing in the effects of the market.

Overall, our results confirm the existence of technical anomalies in ASE, provide strong support for profitability of those technical trading rules, and are in general consistent with those previously reported papers.

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Contribution of the Liberal Economical Thinking to the Industrial Development of Romania (1859-1918)

By
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Abstract

For the strengthening of the national economic organism, through the reformation of the economic and political life of the country, the period 1859-1918 is one of reference. Romania's modernization and development are the result of the contribution brought by the thinkers of the time, especially by the radical liberal thinkers. In the same time, we should not neglect the participation, more modest however, of the conservative thinkers at the economic advancement of the country.

In spite of the good results in the industrial field, industry was still occupying a secondary position in country's economic structure, accounting for approximately 20% of the national income. The development of new industrial sectors reduced the imports of consumption goods, even if, until World War I, the Romanian market was dependent on the West.

In this paper, I want to analyse the liberal thinking from the logical, theoretical and doctrinaire viewpoint and, also, to follow the way this thinking has come true in Romania's long-term development strategy, elaborated by the liberal governments and the practical results obtained on this basis.

Keywords: Liberal economic thinking, industry, modernization, development strategy.

JEL Classification: B1, B15

1. Introduction

The mid-nineteenth century beginning of the twentieth century structure of the Romanian economy, agriculture continued to be the fundamental sector. Even in 1900, it contributed two thirds to the gross national product and it represented three quarters of country's exports. Moreover, agricultural products represented about 85% of exports.

On the eve of World War I, there are signs of changing the industry/agriculture ratio, to industry's advantage, because of some new liberal reforms that changed the country's modernization speed. In spite of the good results in the industrial field, industry was still occupying a secondary position in country's economic structure, accounting for approximately 20% of the national income. The development of new industrial sectors reduced the imports of consumption goods, even if, until World War I, the Romanian market was dependent on the West. The

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evolution of Romania's foreign trade can give the pulse of the economic life of the country.[1]

2. The doctrinaire controversies between the liberal economical thinking

The doctrinaire controversies between the industrialization initiators, concerning the methods, the ways and the concretes actions, which had to be taken, are very interesting and instructive for the studied period (1859-1918). These impose a scientific analysis of the economical realities, socials and political in modern Romania, and in the world, as they were not only some subjective desires, political needs or conjectural criteria.

After they have convincing demonstrated the need of the economical diversity through it's industrialization, the cogitative of the time have approached the problematic methods of possible industrialization, referring at the institutionalised frame where it supposed to develop this process, the function of the state, of the credit units, at the rapport between the foreign and local managers.

The majority of the economists have considered that, for the industrialization of the country it is necessary the development of all the industrial branches for which there were local raw material from the agriculture and silviculture, and also the ores found in the mountains sub sol. P. S. Aurelian sustained that this could be accomplished through the promotion of a program which had to follow "the creation of an industrial business on the level of the country, including the construction of cars, beginning from the capitalize deposit and arrogate a significant purpose to the country in the support of this ambitious program"[2]. A.D Xenopol considered necessary he development of the industrial branches which had as raw material the agriculture products. This owed to the fact that there were no supplementary costs (vamal taxes, commissions) for these products, being made in the country.

Concerning the accent that had to be put on one or the other industry's forms have set two different ideas of the liberal economical opinion, each author distinguishing through certain ideas.

First exposing his point of view concerning this matter was D. P. Martian, which considered that the branches of the industry must development together with the basic branch of economy, the agriculture. In his conception was supposed to "encourage with state means, the founding of manufactures for developing an working class and to set in function the productive forces of the country, developing the agriculture and the industry proportionally, one in the other advantage"[3].

The structure of the industrial branch was supposed to be very captious, beginning with the home industry, the agriculture industry (the one which had to process the farmer products), to the alimentary industry, the forest agriculture, the construction materials and ending with different branches of the hard industry.

D.P.Martian distinguish himself through his preoccupation in finding some possibilities to set the bases of a new industrial branch in our country, which is the hard industry, being convinced that this one, with the material base which it will dispose would make easier the development of the industry, on the whole. The extractive industry would be, according D.P.Martian the cheapest, because of the

[1] The Romanian Academy, *The History of Romanians* (coordonator Berindei, D.), The Encyclopedic House Publishing, Vol. VII, Tom II, Bucharest, 2003, p.104, 113, 129
[2] Aurelian, P.S., *Economical Works*, The Academy Publishing House, Bucharest, 1967, p. 186
[3] Marţian, D.P., quote from *The Encyclopedia of Romania*, Vol. III, *The industry of transformation*, The National Printing Works, Bucharest 1939, p. 280

existence of ores which could be explored "For the salt and stone coals, whom batch is not deep. The exploitation is the easiest and the result in visible, recalculated and addicted from the exploited; for this, the lending to foreigners is the most secured expression"[4] said D. P. Martian in a study named *"About the salt mines of the country"*. This exploitation could be made with the help of the intern forces, not being favourable to the lending of soil wealth to foreigners, whom would have exploited them merciless: "Giving in foreign hands, the cheapest and working production, it is an anti economical idea, at thinking that our government will do it, it is a calamity"[5].

Living in an era where the capitalism penetration was in an incipient stage, D.P.Martian has the merit of facing strongly the conservatory ideology of national defense of the formatting industry.

P.S.Aurelian considered the industrialization process had to be structured through the founding of small industrial settlements, because there weren't enough capitals and workers: "for now we believe that our industrial organization must settle on the founding of domestic and vocation industry". The justification of this affirmation is that, the development of the small industry required small capitals and attracted a bigger mass of people in the productive activity. In time, once with the development of small industry, in the order of accumulation of local capitals" when the economical conditions of the country will change, the big industry will self impose. The big factories want a lot of money, many workers and multiple professional capacities. Indisposition of such means we must start with what we can, with the capitals and workers we dispose"[6]. Here P.S.Aurelian referred to the admonished in the productive activity of the countrymen that hadn't anything to work in the non-agriculture season, according as the local capitals increased, was gone over to the larger factories.

P. S. Aurelian considered that, to assure stability in the industrial branch, had to be studied the realities and requests of the inner market: "To found industry in a country must be searched to found gradually those productions, which can live and endured in the people, becoming a middle of living for it. This doesn't keep down the foundation of big industrial settlements; but we search to found for now appropriate industries with applications, with social and economical statute of the Romanian people. Only by following this we can set the Romanian industry on solid and unshaken basements". The Romanian bourgeoisie in formation didn't allow making investments in the industrial branch from the beginning, in the same manner it didn't resist in the competition with the developed bourgeoisie from the Occidentals countries of Europe. The after effects would have been the investment of foreign capital in the industrial branches. P.S.Aurelian opposed to the penetration of foreign capital in a country, believing that, this isn't a way of industrialization, but a way of quitting of the independent development of Romania. The widen of the inner market for industry could be accomplished through the increased of buying power of the eating population.

The covering essentials steps for the industrial prosperity of the country were considered by P. S. Aurelian "the natural way of economic development in all the countries, and according to this, it couldn't be different in our country"[7]. The big industry can't introduce it self as a system, the economy foundation being a domestic

[4] Marţian, D. P., *About the salt mines of the country i*n Economical works, The Academy Publishing House, Bucharest, 1961, p. 296
[5] Idem, p. 298
[6] Aurelian, P. S., *Economical Works*, The Academy Publishing House, Bucharest, 1967, p. 189
[7] Idem, p. 188

industry and the professions. Through domestic industry was meant "a way between the big industry or the factory and profession, which is the industry practiced by one handicrafts man"[8]. P.S.Aurelian granted a special purpose to the food shop and easy industries, this being placed specially in the urban environment for contribute to a better using of the peasant's time in the country.

The introduction of the industry in our villages has the purpose: 1) will improve the farmers position; 2) will allow to transform good manufactured objects, a lot of prime materials, that will export to the boundaries for receiving them made by the Transylvania farmers; 3) will give to the rural population work, population who losses such a precious time during the year by not having a place of work; 4) will emancipate in part the country duty of bringing from outside the most insignificant objects fabricated; 5) will formed a precious personnel for the factories which will found in the future in the country; 6) will contribute in creating a real national industry in Romania; finally will contribute to the agriculture advancement." said P.S.Aurelian in „How the industry in Romania can be founded"(1881).The effects of the introduction in the villages of the industry will change the statue of the farmer, formatting a power full labor force in the future, will improve the level of living of the families from the country environment, contribute in the same measure at the development of the agriculture. The progressive's ideas of P.S.Aurelian concerning the introduction and development of the industrial buildings in our country had a special significance for the existence of Romanian people and for the economic and social progress.

Among the assurance means of development and prosperity of the founded industries P.S.Aurelian mentions: "bringing of foreigners experts for the introduction of different fabrications, the protection of the industrial production assuring among the abundance of private needs and the needs of different public services"[9].

A. D. Xenopol joins to P. S. Aurelian in the industrialization matter, even if it distinguishes from this under technique aspect concerning the type of industrial settlement that must be first developed. Contrary to P.S.Aurelian idea, A.D.Xenopol sustains the idea of foundation from the beginning of some large industrial settlements, using in this sense of the last results that have arrived at the western people: "the large industry is the one that, we must search to develop it first in Romania"[10]. This because through the big industry were accomplished superior performances, the state being able to support it from financier point of view and also as consumer, assuring the sale market it's products. As well, he doest agree with the theory of P.S.Aurelian that said, that Romania wasn't prepared for the development of the big industry because of the absence of the capitals, whose technique knowledge in the field and the absence of labor men, the only industry that could developed as the domestic industry, this being "the natural way of economic development in all the countries and of course in our country as well"[11]. Even if there weren't in the country sufficient capitals for the foundation of some factories, those could result from "the join stock company, only as much as the factories could present a successful safety"[12]. A.D.Xenopol gives examples of this kind of capitals gathered from national assurance companies ("Dacia", "Romania").

[8] Idem, p. 190
[9] Aurelian, P. S., op. cit., p. 210-211
[10] Xenopol, A. D., *Economical Works*, The Academy Publishing House, Bucharest, 1967, p. 117
[11] Aurelian, P. S., *Economical Works*, The Academy Publishing House, Bucharest, 1967, p. 190
[12] Xenopol, A. D., *Economical Works*, The Academy Publishing House, Bucharest, 1967, p. 180

The big industry has as purpose the production in the country of some products, which were imported until then outside our borders. The small industry had to develop the shelter of the big industry. ”The development of our industry must be done in 2 directions: first, concerning the imported products, in the manner that this had to be made in our country-the big industry, then the Romanian people to go to the industrial work-the small industry”[13]said A. D. Xenopol in “Economics studies”.

The beginning of the industrial development in the country is closely tight to the agriculture: “the industry is necessary even for the well being of agriculture”[14]. The foundation of new industries, which will take the prime materials from the agriculture will be favourable because will determine an intensification and diversity of agriculture crop, through the introduction of some technique cultures, would reduced the volume of raw products, which was unreasonable for us, will reduce the import of finite products from our own raw material, increasing our currency reserve. Also, will increase the working place number and extend the division of work, which will take to our country progress.

When he says big industry, A. D. Xenopol has in minded first the exploitation of pits “the products of pits are as necessary as the cereals”; “the problem of the mines is of much interest”[15].

According to Xenopol, the state must intervene and sustain an industrialization program. Among the means utilized by the state in the purpose of industrialization, A. D. Xenopol enumerate: “re-formation of the education system, the multiplication of those schools which will give birth to productive jobs”, “the encouragement from the state of all the industrialized jobs as: to scholarship gave to the young people that will want to open an industrial settlement by lending some money, organization of industrial competitions for the Romanian workers and awards for those that will excel through them productions”[16].

The state can give its support only in the development of the big industry, “the big industry is the one that what we need to search to develop first Romania”[17] insists Xenopol. But the help from the state has to have a transitory character”. If the help of the state for sustaining the industry would last forever, “then that industry wouldn't have in self no own power of existence; it will be like a plant that lives from the body's juices, from is stickied, and detached from it would die”[18].

Referring to the industrial structure of the country, A.D.Xenopol considered as necessary the made of an industrial product, which will determine the development of an interfering industry.

At the end of the nineteen century was remarked a changing in A. D. Xenopol opinion concerning the industrial branches that could be developed in our country.

The agriculture divisions would be the one that could develop the best. Here we find an overreacting of A. D. Xenopol. The foundation of agriculture industries could ameliorate in a certain measure the social problem of peasants through a diversification of their occupations and the using more efficient of the time especially during winter, creating an intern market wider for the agriculture products. The agriculture industries would have been the basic link for solving the economical problems and socials of the time. At the beginning, A. D. Xenopol offered an

[13] Xenopol, A. D., *Economical Works*, The Academy Publishing House, Bucharest, 1967, p. 117
[14] Idem, p. 89
[15] Xenopol, A. D., *Economical Works*, The Academy Publishing House, Bucharest, 1967, p. 117-118
[16] Idem, p. 120
[17] Idem, p. 180
[18] Idem, p. 186

encouragement perspective to the industrial development of Romania, which offered to his writings a large echo.

The liberals appreciated that, between the agriculture and industry mustn't be antagonism. But, those branches of the economy had to complete themselves and support mutual. The agriculture had its first client in industry, while the industry supposed to use in the production processes the agricultural products.

Vintila I. Bratianu appreciates with the occasion of talking about the customhouse tariff from 1904 that "Industries that concern more our country are those that rely on the using of the agricultural products"[19]. In his opinion, it was necessary the development of those branches which count on the import of raw material, "because some industries, through their nature can't found in the small industry"[20]. It wasn't the right time to discuss about a big industry, but it wasn't supposed to neglect such an industry, because "until we will be an agricultural, industrial, commercial country, it wouldn't be our development complete"[21].

3. The practical results in industry

In accordance with the existent documents, in what concerns the industrial sector, after the endorsement of the first law of encouraging the industry and until 1912 "were set up 769 factories and were closed 274, remaining, out of the new created, 495 factories."[22] Our industry lacked in this period the fuel too, "which we started to own only since 1900"[23]. After 1900, the greatest development among the existent factories was of those that used domestic raw materials.

In 1914, according to the studies done, the industry covered, on the average, only 25-30% of the domestic market demand for consumption; therefore, industry had a rather secondary position in country's economy, contributing only 20% to the national income. Some industrial sectors (metallurgy, the machines buildings) did not exist yet, "the need for machines and tools being covered by imports, especially from Germany"[24].

The most considerable industrial inquiry is that one from 1901-2, where again we find the statistic data regarding the evolution of the processing industry on categories, such as[25]:

[19] Brătianu, V. I., *Writings and reflections*, Vol.I, The Independence Publishing House, Bucharest, 1937-1940, p. 155
[20] Brătianu, V. I., *Writings and reflections*, Vol.I, The Independence Publishing House, Bucharest, 1937-1940, p. 155
[21] Ibidem
[22] *The Encyclopedia of Romania*, Vol. III, *The industry of transformation*, The National Printing Works, Bucharest 1939, p.812
[23] Ibidem
[24] The Romanian Academy, *The History of Romanians* (coordinator Berindei, D.), The Encyclopedic Publishing House, Vol. VII, Tom I, Bucharest, 2003, p.113
[25] Axenciuc, V., *The Economical evolution of Romania, Statistical – Historical Researches, 1859-1947, The Industry*, Bucharest, 1992, p.21

Table 3. *The processing industry on categories*

Source: Axenciuc, V., The economic evolution of Romania. Statistical - historical researches, 1859-1947, The Industry, Bucharest, 1992, p. 21.

Category	Unities		Mechanical Power		Staff	
	Number	%	CP	%	Number	%
TOTAL	61953	100	60745	100	162630	100
Big Industry (mechanized)	625	1,0	45212	74,4	39746	24,4
Small Industry (handicraft)	54405	87,8	236	0,4	105031	64,6
Special Industries (mills, saws, bags)	6923	11,2	15297	25,2	17853	11,0

From the table it results that the little industry had the largest weight in industries' total (87, 8%), followed by the special industries (11, 2%), and last but no least, but with a decreased weight, by the big industry (1%). The majority of employees (64, 4%) worked in the little industry, followed by the number of employees from the big industry (24, 4%) and from the special industries (11%).

To understand better the signification of the statistical information supplied by Victor Axenciuc, we have to see what it is understood through *staff*, through *big, little industry* and *special industry.* Thus, *the staffs include* the employer, administrative and technical staff, workers and apprentices. The big industry refers to that category of state and private enterprises or to other public institutions, which have in common three elements: the use of mechanical power for machines, at least 10000 lei invested capital in fixed capital and at least 5 persons as the staff used. By small and middle industry, the inquiry was actually referring to the small industry, including all the production unities for raw material transformation that do not respect the criterions for 'big industry', prevailing the professions with big and small workshops, private and public and of other public institutions. Here are not included the itinerant professions (ironsmiths, whetstone grinders), some services (barbers, hairdo, public bathrooms) and the professions with agricultural character (dairy, cheese dairy). Within the framework of the *special industries* there are the small enterprises, especially the rural ones that could not be framed in the 'big industry', since they did not respect to the criteria, but neither in the group of 'professions', since they outrun those by function and means of production.[26]

To follow the development of the big industry between 1886 and 1915 and to demonstrate the positive results recorded, I have selected information from the statistics worked out by Victor Axenciuc[27], as it follows:

Table 4. *The big enterprises (1886-1915)*

	1886	1915	Average yearly growth
Number of enterprises	83	837	25
Fixed capital (millions of lei)	About 38	361	11
Value of the industrial production (millions of lei)	About 40	584	18

Source: Axenciuc, V., The economic evolution of Romania. Statistical - historical researches, 1859-1947, The Industry, Bucharest, 1992, p. 21.

[26] Ibidem, p. 21
[27] Ibidem, p. 21

Thus, it can be represented graphically the synthetic expression of the development of big industry such as:

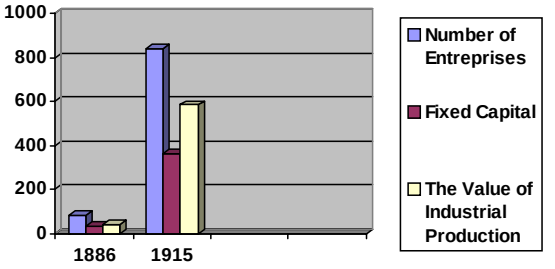

Figure 5. The development of big industry

Source: Axenciuc, V., The economic evolution of Romania. Statistic-historical researches, 1859-1947, The Industry, Bucharest, 1992, p. 21.

It should be noticed that in the period 1886-1915, the number of enterprises increased 10 times, the capital 9,5 times, and the value of production over 14 times, fact that demonstrates once again the advancement, the fast starting of industry, fact that expresses the influence of the liberal doctrine.

In this period also, the extractive industry had a considerable development. Romania occupied the fourth place in world oil production.

4. Conclusions

The development and the modernization of the Romanian society, of the Romanian economy at the end of the nineteenth century, the beginning of twentieth century, is due in principle to the political elite, especially the liberal one, without underestimating the conservative political elite. Although the opinions of liberals and conservatives differed over the ways, the methods an especially the modernization rhythm, "the contribution regarding the public institutions' participation in the process of infrastructure and public edifices building is sensible equal"[28]. The liberal ideas, the radical ones especially, had a remarkable impact on the economic life in Romania in the modern period, contributing to our country's integration in the international economic circuit.

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[28] The Romanian Academy, *The History of Romanians* (coordinator Berindei, D.), The Encyclopedic House Publishing, Vol. VII, Tom II, Bucharest, 2003, p.51

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Productivity Improvements in Education: A Replay

By
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Abstract

Productivity is a measure of how well resources are utilized to produce output. It is defined as a ratio of outputs to inputs. Then to manage productivity is to achieve more outputs for the same inputs, usually measured in money terms or the same outputs for less input. The modern notion of productivity includes both organizational efficiency and effectiveness. In education outputs are principally represented by teaching, outcomes by learning. The definition of productivity should not be confused with efficiency and effectiveness. Effectiveness is a measure of the outcome of an operational unit like a school or a university department. It is a measure of how well an operational unit was able to accomplish its objective. Efficiency is a measure of the degree to which an operational unit utilizes appropriate resources in the right manner.
The purpose of this paper is to analyze and critique the assumptions and developments of productivity measures, present productivity models with the main factors that affect behavioural and cognitive learning and to focus on the developments of productivity improvements in elementary, secondary and higher education.

Keywords: Productivity in education, efficiency, effectiveness, models of productivity

JEL classification: I20, I21, I23.

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1. Introduction

Education is an area of public service that is encountering increasing scrutiny and criticism for its low quality and productivity. Educators are being called on to function in an effective and efficient manner. In addition they are expected to adapt policies and methods that will permit even greater productivity.

The subject of "productivity" often evokes emotional, polarized reactions from labor, management, unions, stockholders and customers. Yet much more is said about productivity than is known on the basis of sound research and theory. Frequently, scholars and practitioners alike refer to "productivity" and "quality" as if they were two separate performance measures. Yet a significant part of any productivity equation is quality. There is no economic value in increased output levels if the increase is offset by lower quality. According to OECD (1989), "The pursuit of quality in education cannot be treated as a short-term, one-off exercise. It is a permanent priority. Education is not an assembly-line process of mechanically increasing inputs and raising productivity. How to improve its quality raises fundamental questions about societal aims, the nature of participation in decision making at all levels and the very purpose of the school as an institution."

Improvements in the educational attainment of the workforce have been a consistently important source of gain in labour productivity and the research and development activities of institutions of higher education have been major sources of innovation. Yet, the education industry's own performance appears poor. Costs have been rising steadily above the rate of wage increases, while labour productivity—in terms of students per teacher—has declined. A surprisingly limited amount of work has been devoted to measuring the output and productivity of the education industry, particularly within the growth accounting framework that applies to other industries.

Part of the difficulty is that many educational institutions are in the government sector and thus lack the competitive pricing that leads to a straightforward measure of output and productivity. In addition, education is an area where progress in measurement has been stymied by long-running debates over perceived changes in the quality of output.

2. Measuring Productivity in Education

Productivity measurement is difficult in most service industries and education is certainly no exception. Some observers seem to assume that quality "must" be higher when the student-faculty ratio is lower. Although one-on-one teaching has its place, some educators argue that a class of 25 is often better than a class of 5 because of student interaction. In any event, when we study productivity it is important to measure output directly and not make assumptions about what the case must be.

Before any measurement of productivity administrators need to decide what level or levels of the organization's productivity should be measured. For example, is the productivity of an individual, say a professor or an administrative assistant, or is the productivity of an academic department or a university as a whole? An important is that measures should not be constructed prior to setting goals and objectives. Doing so will lead administrators to value something that is measurable rather than measuring something with value.

Measuring productivity in education requires a measure of both efficiency and effectiveness. Efficiency is often measured using ratios, such as physical output relative to an input or money cost of an input relative to an output. The exact

efficiency measure used depends upon the objective set by the administration. Efficiency ratios such as enrolment per section or contact hours per faculty member are reasonable and useful. An objective of improving students' progress toward a degree would require measures such as a withdrawal rate and average course load taken. Examples of cost-efficiency measures include instructional costs per student, library expenditures per student, and administrative costs per student.

Measuring effectiveness can be difficult, though not impossible. Several ideas have been suggested in the literature. One way to measure effectiveness is to assess community or client conditions and benchmark them to community standards or those standards of other institutions of higher learning. An example could be the number of graduates who find a job within three months of graduation. Another option is to measure accomplishments, such as the number of graduates or the percentage of students taking a class that requires relatively advanced work, such as technical research paper. The number of graduates going on to receive advanced degrees is an alternative measure. Finally, client satisfaction is a third avenue to measure effectiveness. Clients can include alumni or businesses that frequently hire a university's graduates.

3. Productivity Improvement

Achieving excellent and acceptable levels of productivity requires careful attention to the following:

Adequate work climate and teamwork

Productivity improvements at the source are possible if the work environment is conducive to innovation and individual creativity. Total teamwork between management and employees, unions and other functional areas of the organization is also essential. An environment where school teachers and managers are able to participate in problem solving, decision making, process changes and planning improved performance provides fertile ground for improvement in productivity.

b. The right training

Training is essential because it prepares everyone to do his job well, by building the right knowledge for logical and intelligent actions and decisions. Well trained people attain efficient work habits and positive attitudes that promote co-operation and teamwork.

c. A balanced emphasis on people and service management

Often the pressure to provide more services can lead to neglect of employee development, degradation in the morals of employees and breakdown in communication within the organization. Productivity improvement requires focus on people and product requirements. The manager's role in the improvement process is to provide the right level of encouragement, training, guidance, support and help as required. Employees also have very important roles to play in ensuring that there is a mutual trust and confidence required to deliver the final output successfully.

d. Creation of awareness among management and employees

Everyone within an organization has both internal and external customers. The notion that educational service quality is only important to the final customer outside the organization should be discouraged. Increasing productivity at the individual level ensures that excellent services are delivered to the ultimate customer.

e. Adequate focus on providing the fundamentals at productivity excellence

The fundamentals of productivity excellence are the corner stones of process and program enhancement that lead to productivity improvement. Some of these fundamentals are:
Management and employee commitment
Process innovation
Adequate reward system
Systems innovation
Goal setting
Error cause removal

f. Adequate measure and data

Everyone within the organization is trained on how to use the various measures for planning, improvement and control. For measures to be meaningful and useful there is the need to collect accurate data.

g. Focus on managing the total system requirements

Productivity improvement at the source cannot be achieved through piecemeal ideas, actions and controls. Very good productivity results are obtainable through focusing on managing the total requirements of each operational unit as well as the total organization. Managing the total requirements involves the use of managerial skills to provide the right direction, supervising at the right level, defining responsibilities adequately, providing positive reinforcement, motivation, recognition and encouragement.

4. General Approaches and Principles

4.1. General Approaches for Productivity Improvement

Each organization or educational unit has its own unique productivity problems. The choice of which approach is likely to be successful depends on the type of problem to be solved and the prevailing circumstances with the educational unit under analysis. The following approaches are recommended:

a. Work simplification and operation improvement

Work simplification is the systematic investigation and analysis of present work systems for the purpose of developing easier, quicker and more economical ways of providing high quality services.

b. Goal clarification

This approach focuses on identifying specific goals and objectives that will improve productivity, implementing these objectives and providing on- going assessment of the strengths and weaknesses of an organization.

c. Incentive systems

This approach focuses on methods and techniques for motivating individuals and work groups. The three most commonly used motivational approaches are the traditional economic incentive approach, the human relationship approach and the self-drive approach.

d. Helping the working employee

This approach focuses on identifying specific people oriented problems that affect employee performance.

e. Improving the task at the operational unit level

This approach focuses on thorough analysis of each task and elements at the operational unit level. The purpose of the task analysis is to eliminate barriers and bottlenecks that affect productivity.

f. Improving technology at the operational unit level

This approach focuses on selecting appropriate technologies that improve productivity.

4.2. General Principles for Productivity Improvement

The comprehensive use of the 6C principles of Control, Coordination, Co-operation, Contribution of analysis, Communication and Cost avoidance, assist productivity improvement analysts to be successful in managing productivity improvement attempts. More specifically:

a. Controls

It is important for the successful implementation of the project to define the objectives and understand the activities involved. Performance measures such as productivity ratios, cost curves and control charts should be used in measuring the results of implementing the objectives.

b. Coordination

Coordination of all activities can be achieved by designating a project manager to be in charge of these activities. He ensures that all project resources are controlled and allocated properly and that the project is going according to schedule. The successful project manager is one who has good interpersonal skills, good judgment and good organizational abilities.

c. Cooperation

The cooperation between members of productivity project team is a key requirement for success. Where the physical presence of all the team work members is impossible, communication channels should be put in place to promote cooperation.

d. Contribution of analysis

The contribution analysis of each phase of the improvement project can be performed by using the variable and result mapping technique which requires that for each activity performed the expected result must be matched against the true output or result. This provides a way of identifying deviations from project goals and objectives, as well as of understanding the causes of deviation from specifications.

e. Communication

Meetings for discussing open issues. On going communication among project team members is required to avoid things falling through the cracks.

f. Cost avoidance

It is required in order to avoid cost overrun in productivity improvement project implementation. Additional functions without value added should be avoided.

5. Models of Productivity Measurement and Improvement

5.1. General descriptive models of productivity improvement.

The primary purpose of a productivity model is to provide a conceptual blueprint of the complex interrelationships and interactions of the many factors that influence the quantity and quality of service output. The following four general descriptive models serve this purpose:

a. An organizational productivity disaggregating model

This model subdivides inputs, conversion technology and outputs into useful subclasses. The rational for selecting inputs and outputs as variables to be subdivided into classes, is that these are the basic components of a productivity index. Organizational productivity is used to measure a family of productivity measures. It is likely that organizational productivity measures will result in different families of measures depending upon the level within the organization that is being measured.

Sociotechnical systems have been proposed as a method of viewing organizations (Davis and Taylor, 1972). There are a multitude of psychological – sociological instruments to measure behavior and individual beliefs concerning the social aspects of productivity (Adam et. all. 1981)

b. Sutermeister's model of worker productivity

Sutermeister (1976) presents a comprehensive descriptive model which is a series of concentric circles surrounding productivity with factors closer to the centre

being more direct in their influence on productivity. The model divides all factors into two groups. The first is the technological development and the second the employee's motivation. Motivation is a function of ability and employees' job performance. Ability is composed of skill and knowledge whereas job performance is influenced by individuals' needs and the physical and social conditions at the workplace. Sutermeister's model provides an excellent overview of the many factors involved in productivity improvement.

c. A conceptual schematic model of factors affecting productivity

This model incorporates the major factors, both organizational and extra organizational that have a direct casual effect on the productivity of the individual employee. Major factors in this model of productivity are represented by rectangles. Circles are used to denote factors that act as filters or butters within the influential relationship between two major factors. Productivity in this model is a function of three primary factors. First the capacity at the task, second the individual effort brought by the worker to the task and third the interference that cannot be controlled by any individual. These three factors are combined through some form of work measurements to yield productivity data for the individual in some specified time period.

d. An input – output model of the organization productivity

The purpose of this elementary model is to emphasize that productivity is a function of all of the various inputs to the production function. This model focuses in productivity and enlarges it relative to the other factors in this system. In this model six sources of inputs are identified and combined within the total productivity. An attempt is made to indicate how these inputs are converted into goods or services. Output is a function of all these factors and productivity is a function of both the level of the inputs and the way in which they are combined.

5.2. Walberg's Model of Educational Productivity

According to Walberg (1981, 1983, 1986), nine factors are required to be optimized in order to increase affective, behavioural, and cognitive learning. These nine factors are consistent, and widely generalizable. The proposed theory of educational productivity has the following groups of factors:

a. Student aptitude variables

1. Ability or prior achievement, as measured by the usual standardized tests;
2. Development, as indexed by chronological age or stage of maturation;
3. Motivation, or self-concept, as indicated by personality tests or the student's willingness to persevere intensively on learning tasks.

b. Instructional variables

4. Quantity of instruction **(**amount of time students engage in learning);
5. Quality of instruction**,** including psychological and curricular aspects

c. Educationally stimulating psychological environment

6. Home environment;
7. Classroom or school environment;
8. Peer group environment outside the school;
9. Mass media environment, especially amount of leisure-time television viewing.

The first five aspects of student aptitude and instruction are prominent in the educational models of Benjamin Bloom, Jerome Bruner, John Carroll, Robert Glaser, and others (see Walberg, 1986, and Chapter 4 for a comparative analysis). Each aspect appears necessary for learning in school because the student can learn very little. Large amounts of instruction and high degrees of ability, for example, could count for little if students are unmotivated or if instruction is unsuitable. Each of the first five factors appears necessary but insufficient for effective learning. High-quality instruction can be understood as providing information cues, correctives, and positive reinforcement or encouragement that insures the fruitfulness of engaged time. Careful diagnosis and tutoring can help make instruction suitable for students. Inspired teaching can help students to persevere. Quality of instruction, then, may be considered an efficient enhancement of study time.

The four remaining factors in Walberg's model are environmental variables. Three of these environmental factors as the psychological climate of the classroom group enduring affection and academic stimulation from adults at home and an out-of-school peer group with its learning interests, goals, and activities influence learning in two ways. Students learn from peers directly. These factors indirectly benefit learning by raising student ability, motivation, and responsiveness to instruction.

Classroom morale is measured by obtaining student ratings of their perceptions of the classroom group. Good morale means that the class members like one another, they have a clear idea of the classroom goals, and the lessons are matched to their abilities and interests. In general, morale is the degree to which students are concentrating on learning rather diverting their energies because of unconstructive social climates. Peer groups outside school and stimulating home environments can help by expanding learning time and enhancing its efficiency. Students can both learn in these environments becoming able to learn in formal schooling.

The last factor, mass media, particularly television, can displace homework, leisure reading, and other academically stimulating activities. It may dull the student's keenness for academic work.

In addition to encouraging and supervising homework and reducing television viewing, parents can improve academic conditions at home. What might be called "the alterable curriculum at home" is much more predictive of academic learning than is family (Walberg, 1984). This curriculum includes informed parent–child conversations about school and everyday events; encouragement and discussion of leisure reading; monitoring, discussion, and guidance of television viewing and peer activities; deferral of immediate gratification to accomplish long-term goals; expressions of affection and interest in the child's academic and other progress as a person.

Cooperative efforts by parents and educators to modify alterable academically stimulating conditions at home had beneficial effects on learning (Walberg, 1984).

Sticht and James (1984) have pointed out that children first develop vocabulary and comprehension skills by listening, particularly to their parents before they begin school. As they gain experience with written language between the first and seventh grades, their reading ability gradually rises to the level of their listening ability. Highly skilled listeners in kindergarten make faster reading progress in the later grades, which leads to a growing ability gap between initially skilled and unskilled readers.

The educational productivity model of Walberg does not contain interaction terms and, instead, it is assumed that the factors interact by substituting for one another with diminishing returns. This can be contrasted with the way that researchers typically conceive of interactions (e.g., aptitude-treatment interactions) in terms of different types of students achieving differentially under alternative instructional methods.

Other social factors not included in the productivity model influence learning in school but are less directly linked to academic learning. For example, class size, financial expenditures per student and private governance (independent or sectarian in contrast to public control of schools) correlate only weakly with learning, especially if the initial abilities of students are considered. Thus, improvements in the more direct and more alterable factors contained in the model in Exhibit A hold the best hope for increasing educational productivity (Walberg & Shanahan, 1983).

5.3. Carroll Model

Carroll (1963) argues that the basic component of a model of learning is time. The degree of learning is a function of the engaged time divided by time needed. Engaged time is equal to the smallest of three quantities. Opportunity or time allowed for learning, perseverance or the amount of time a learner is willing to engage actively in learning and aptitude or the amount of time needed to learn, increased or decreased by whatever amount of time is necessary as the result of the quality of instruction and the ability of the pupil to understand instructions. This last quantity (aptitude or time needed) is also the denominator in Carroll's equation:

Degree of school learning = f (time spent/time needed)

This emphasis on time or quantity of schooling has been incorporated in many subsequently developed models. Cooley and Leinhardt (1975, 1978 and 1980) re-labelled many parts of Carroll's model and preferred to study the classroom rather than the individual. This emphasis seems appropriate because most instruction takes place in groups and not individually. The four constructs in Cooley and Leinhardt's model were motivators, opportunity, the quality of instructional events, and the structure of instructional material.

Other models in which time is emphasized include those of Berliner (1979), who emphasized the kinds of teacher behaviours and instructional practices that increased academic learning time, and the mathematical models of Lau (1978) and Hanuschek (1979) that related achievement and time components. These 'time' models concentrate primarily on the various factors that affect time spent on task. Classroom environment and school effects are of peripheral importance as they contribute only to individual time-on-task.

5.4. Bloom's Model

Bloom (1976) switched emphasis from time-on-task to the learning history of the student. As it is stated in page 7 of his work "What any person in the world can learn, almost all persons can learn if provided with appropriate prior and current conditions of learning". The key to successful learning lies less with time and more with the extent to which students can be motivated and helped to correct their learning difficulties at crucial points in the learning process. While not explicit in Bloom's model, feedback is an important attribute. Bloom placed considerable emphasis on the cognitive characteristics that a pupil brings to the learning task. These characteristics, he claimed, were the single most dominant factors in predicting learning outcomes.

A major feature of Bloom's model is the provision of guidelines about the relative importance of the various facets of the model and the overall explanatory power of the model. Bloom estimated that cognitive entry behaviours correlated positive with a coefficient of about 0, 75 with academic achievement. Affective entry behaviours and quality of instruction correlated positive with a coefficient of about 0.50 with achievement. Together the three facets correlated 0.95 with achievement.

Thus, Bloom's model could account for more than 80 percent of the variation in the level or rate of achievement (Bloom, 1976). Under ideal conditions, the combination of all three facets could account for as much as 90 percent of the variation.

5.5 Glaser's Model

Neither Carroll nor Bloom and their successors pay much attention to learning processes. Indeed, Glaser (1980) pointed out that aptitude, learning, and instruction traditionally have been kept at a distance from each other. To minimize this distance, Glaser envisaged various macro- and micro-theories of teaching and instruction. Macro-theory concerns the large practical variables dealt with in schools. As it is stated in page 324 of his work "…such as the allocation and efficient use of time, the structure of the curriculum, the nature of feedback and reinforcement to the student, the pattern of teacher student interaction, the relationship between what IS taught and what is assessed, the degree of classroom flexibility required for adapting to learner background and the details of curriculum materials. Such variables need to be part of a theory of instruction (and), as this theory develops; it will be under girded by the more macro-studies of human intelligences, problem solving, and learning".

Glaser is representative of many recent psychologists/educators who have outlined models of learning primarily related to learning processes (Case, 1978; Greeno, 1980; Scandura, 1977; Sternberg, 1977). These models provide concentration on the procedures for effective learning and emphasis on the importance of feedback between learning processes and achievement outcomes. The models do not provide a focus on the role of the teacher, school, or curriculum in terms other than how these factors impede or aid the processes of learning. Glaser (1976, 1977, 1980 and 1982) identified four essential components for producing student learning.

a. Analysis of competent performance which includes identification of the information structures required for performance, as well as a description of the cognitive strategies that apply to the learning task.

b. The description of the learner's initial state which is similar to Bloom's cognitive entry behaviours.

c. The transformation process between the initial state and a state of competence; this is the unique contribution of Glaser-type models.

d. The assessment of the effects of instructional implementation. This assessment can be both short-term (immediately in the context of learning) or long-term (generalized patterns of behaviours and the ability for future learning).

5.6 Fraser's et al A Synthesis of Models

A number of critical elements of the above models have been incorporated by Fraser et al. **a.** This rearrangement places the pupil in the centre of the various influences. The three components in the box pupil, learning processes/methods of instruction, and outcomes are closely entwined. **b.** There is an allowance for feedback between appropriate components. While there can be reciprocal relations between every element, some lines can be omitted. For example, instructors and social factors of pupils seldom interact in their effects on school learning. **c.** It is the outcomes of the learning processes that typically affect the instructor and the instruction. To some exteme, this could be considered unfortunate in that it would be desirable that pupils' learning processes have more direct feedback on the instructor and instruction. But, for others, this could be fortunate in that modifications should be made relative to achievement outcomes not improved processes. Perhaps some of the researches on learning-to-learn can serve as a middle ground (e.g., Anzai & Simon, 1979; Greeno, 1980: Klahr & Wallace. 1976). **d.** The model not only has cognitive outcomes, but also has affective outcomes. The disposition to learn is a critical goal of this model of learning. Should a child acquire a favorable attitude to learning during the school years, this probably will have more impact on subsequent life-time learning than increased school achievement. Affective components include self-concept, self-actualization, and reciprocity (Rawls, 1971). **e.** The role of learning processes and learning styles are clearly specified. **f.** The outcomes apply to both general and specific cognitive outcomes.

6. Productivity in Elementary and Secondary Education

In the USA unlike most sectors of its economy that steadily increase their productivity over time, schools become less rather than more efficient, a serious matter given the size of the education sector and the central and increasing importance of learning in the American economy and society. School productivity or the relation of achievement to costs was 65% higher in 1970–71 than in 1998–99 (Hoxby, 2001).

6.1 Factors that affect learning

One of the purposes of this section is to present some of the large-scale surveys that reveal the factors that affect learning.

Though economic, sociological, and political factors affect learning, their influence is indirect. Learning is fundamentally a psychological process; student motivation, instruction, and other psychological factors are the well-established, consistent, and proximal causes of learning. Thus, we start with psychological factors before analyzing the social conditions that affect learning directly.

Herbert Simon, the Nobel economist and psychologist, combined these fields to synthesize what might be called the economics of cognitive learning. His synthesis sets the stage for understanding what helps students learn. If a lifetime were devoted to acquisition of information, according to Simon's estimates, about 200 million items could be stored. "Hence, the problem for humans is to allocate their very limited

processing capacity among several functions of noticing, storing, and indexing on the input side, and retrieving, reorganizing, and controlling his effectors [actions] on the output side" (Simon, 1981, p. 167).

Language mastery, the fundamental and pervasive skill necessary for achievement in school, is determined more by experience than by psychometric intelligence. Decisive is the amount and intensity of the experience rather than age or psychometric intelligence (Walberg, Hase, & Rasher, 1978).

To foster learning, that it can best provide logical, readily understood explanations suitable to learners as well as the time, opportunity and incentives for them to learn. These simple, commonsense principles set the stage for understanding research on the psychological causes within and outside school that foster achievement.

Practice makes perfect, says an old adage. An analysis of time effects on learning suggests the obvious: 88% of 376 study estimates revealed the positive effects of various aspects of study time such as preschool participation, school attendance, amount of attention to lessons, amount of homework, and length of the school year (Walberg, 1998b). The positive effect of time is perhaps most consistent of all causes of learning.

This taxonomy of nine factors in three sets derives from an early synthesis of 2,575 study comparisons (Walberg, 1984) suggesting that these factors are the chief psychological causes of academic achievement. Subsequent syntheses have shown results consistent with the original findings. Each of the first five factors—prior achievement, development, motivation, and the quantity and quality of instruction—seems necessary for learning in school. Without at least a small amount of each factor, the student may learn little. Large amounts of instruction and high degrees of ability for example, may count for little if students are unmotivated or instruction is unsuitable. Each of the first five factors appears necessary but insufficient by itself for effective learning.

6.2 Motivation

Motivation as a form of human resource development can be tailored into greater productivity for teaching professionals with the development of a strong organization and a positive working environment. With the United States economy becoming ever more interdependent on the global economy motivation of professionals and an understanding of employee behavior in educational facilities has taken an even greater importance. Schools in the public and private sector should continue to view staff members as an asset. Personnel will be able to achieve high levels of productivity and a positive working environment.

Teacher motivation and its effect on the educational process have been examined and analyzed in detail from the early educational reform movements in New England to present day educational theorists. Motivation and productivity can be enhanced through the situational/environmental approach. Traditional administrative practices may prove to be obsolete or no longer useful.

a. Tailoring Motivation into Productivity

Employee satisfaction and productivity are goals that administrators should stress in order to accomplish the objectives of an educational facility, whether those decisions are made through a traditional or non-traditional approach. However,

principals should accept the diversity of human attitudes, feelings and motives and professionalism while working with each teacher to personalize his/her needs.
Moreover, as commercial concerns broadened, Lawrence (1975) believed that individual interests should be adapted to increase motivation, morale, and productivity, thereby reducing employee turnover and alienation within the organization.

While motivation varies between individuals, the administrator in the current educational climate must understand the beliefs, desires, and values of his or her employees and how these attributes will affect job performance. The ability to understand motivated behavior of employees is only the initial stage. Limited unmotivated behavior is the desired outcome for administrators and managers alike.

Much motivated research has concluded that a strong organization and positive work environment will encourage, and even promote greater motivation and productivity. Administrators who offer professional employees the possibility of doing new and original tasks in an effort to motivate them to set high standards of performance often exceed organizational standards.

Motivation itself is closely associated with how much students can learn. Multivariate analysis of surveys and control-group studies of reinforcement corroborate its causal influence. This effect sharply contradicts the prevalent idea in education that learning must be intrinsically motivated for its own sake.

b. Home Environment

The effect of the home environment can be taken very seriously for several reasons. Control-group studies corroborate many correlational findings. The home effect is far larger than apparent socioeconomic effects. Something can be done about home environments. School–parent programs can help parents academically stimulate their children by reading to them, taking them to libraries, guiding and discussing leisure television viewing, cooperating with home visitors and teachers and similar practices.

c. Grouping

Grouping students reflects common sense. If students with similar levels of knowledge and skills are grouped together, teachers can avoid teaching them what they already know and what they are yet incapable of learning; with instruction more suited to them, students should find learning more efficient and pleasant.

d. Student Incentives

Similarly student incentives particularly high standards, promote learning. The threat of grade retention, for example, can serve as an incentive for greater effort, although intensive remediation seems necessary.

This section will focus on the developments of productivity improvement appropriate to that segment of education called schooling, specifically in public elementary and secondary schooling.

If the only purpose of schools were the dispensation of knowledge or the provision of training and skills the selection of a productivity indicator would be straight forward. The numbers of children enrolled in school or the numbers of hours of teaching provided are a set of output measures. The fact that the above mentioned, less noted services are provided by schools make the choice of indicators more

complex. The difficulty with output indicators is the selection of which indicator is the best measure of a schools performance. Schools priorities are shaped through a political process and the multifaceted school programs reflect the outcome at such a process. Schools exist for all the above purposes with others that have not been listed.
The roots of school improvement can be seen historically as having two-distinct threads of research: the first, spanning many years, is concerned with educational innovation; while the second is more recent and involves the study of effective schools.

Loucks- Horsley and Hergert (1985) in a very useful Action Guide to school Improvement state some of their beliefs which appear to contradict the conventional wisdom about improving schools.
Considerable work has been undertaken on the study of educational innovation, and this is admirably summarised by Michael Fullam in his book, "The meaning of Educational Change (1982)".

6.3 Effective Schools

In recent years a lot of research has developed on effective schools and excellent reviews of the literature are provided by Purkey and Smith (1983) and Rutter (1983). Schools, in which students achieve good academic results, after controlling for home background factors and ability measures, are called "effective". While a number of methodological problems exist, including the narrow definition of outcome measures largely in terms of academic achievement the different studies have produced fairly consistent findings and have identified a set of factors which seem to be related to pupils' performance.

Most of these approaches have seen schooling as something that is done for the students, rather than thinking about education as something that students essentially do for themselves. An argument is developed that makes students the key factor in shaping school's outcomes and therefore a central issue of our thinking about productivity.

Of course such an argument is a simplification and not uncontroversial. One could take issue with every statement within it. For example, there are all sorts of reasons beyond spending levels as to why students and schools perform the way they do. In many countries public support for education remains high, and there is not the same sense of crisis that envelops education policy in the United States. Some critics see the attack on schooling as a neo-conservative effort to move away from commitments to equity and the public sector (Boyd, 1991). But those who criticize the neo-conservative agenda in education they have also concerns about the quality and appropriateness of schooling. Regardless of the political solution advocated, it seems that systems of mass schooling are not as effective as they should or could be. One way of thinking about this problem is to see it as a problem of productivity.

The leading writer on production functions in elementary education is David Monk of Syracuse University. In his book, *Educational Finance: An Economic Approach (1990),* and in an article in *Educational Evaluation and Policy Analysis (1992),* Monk outlines an informed and sophisticated view of the history of educational productivity studies and of the status of thinking in the area. His work is the most complete published analysis of the literature on educational production functions and stands as the definitive synthesis of present knowledge. Monk's basic view is that production studies of schooling have not yielded very much useful

knowledge yet and therefore they face serious obstacles to doing so, but that it is too soon to give up on the attempt.

Monk uses the production function as the basic element for studying productivity in schools. He defines a production function as a model which links conceptually and mathematically outcomes, inputs, and the processes that transform the latter into the former in schools. He notes that production functions are important for improving both technical and allocate efficiencies. However, despite their potential benefits, Monk recognizes the major obstacles that face the creation of production functions for education. Outcomes, inputs and processes are not easily understood.

Monk is aware of the difficulties in dealing with both micro and macro analyses. He concludes that there is no any other better approach. As he points out in page 327: "... it is not always the case that micro-level data are better than macro-level data. The proper level of analysis depends largely on the nature of the phenomenon being studied. Some phenomena are district rather than school or classroom phenomena and have effects that are felt throughout entire school districts".

The inputs of the school itself are relatively easy to recognize--buildings, teachers, textbooks, and the like-- although Monk notes difficulties here, too, in knowing which inputs do reach students, and in what form.

What does it mean to say that a resource flows to a student? A teacher might spend time providing tutorial instruction for a single student. But the student may or may not be attentive to the instruction being provided. The student may "... decline the assistance, either overtly or covertly. In such a case, did the resource flow, as he points out in page 328.

Time is another significant problem for studying educational productivity. It seems reasonable to believe that students will learn at different rates. Yet this seemingly innocuous conclusion creates enormous difficulties for analysis, since it means that different resources at different times and in different arrangements may be necessary for different students. Indeed, there could be a unique production function for each child or even several functions for each child under different circumstances as it is stated in page 344 in Monk's book.

Analysts also agree that learning is influenced significantly by factors outside the school. A vast array of home and background variables, Monk indicates, have been used at various times as part of the specification of the inputs of schooling, not always accompanied by a strong theoretical rationale for their importance. Even when identified, these input variables are difficult to measure. Monk cites intelligence as a particularly important and difficult to resolve instance.

Finally, as if these problems were not enough, Monk mentions various technical problems for studying productivity in education. These include the limited variation among schools in many of their attributes, the possibility that both input and outcome variables are collinear, and the likelihood that inputs and outcomes influence each other. Finally, there is the real possibility that certain aspects of education are "anarchistic," by which Monk means that actors are not goal-oriented, so that even if the best way of doing things was known, people would not pay attention to it as it stated in page 339.

Monk raises the possibility that there is no production function for education. In page 342 of his book, he states that no "systematic process governs the transformation of inputs into outcomes" (p. 342). Many of the same themes are reprised in Monk's (1992) article. He begins by pointing out the current policy towards what he calls "outcomes as standards". He notes that there is a paradox

between pessimistic assessments of productivity research in education and the growing drive towards improving productivity which requires "a nontrivial store of knowledge regarding the ability of state, district, and school officials to enhance productivity" as it is stated in page 307. Monk's view is that
"...the underlying model of education productivity is inadequate and has not evolved much.... The weakness of the conceptualization gives rise to much of the policy-making frustration" (p. 308), "...(a) it is premature to conclude that the production function lacks meaning within education contexts; (b) ...approaches to the outcomes-as-standards policy-making response have merit and involve increased efforts to monitor and make sense of the experimentation that occurs; and (c) the embrace of the outcomes-as-standards response ought not to crowd out alternative, more deductively driven strategies." (p. 320).

Monk goes on to advocate the study of productivity through looking at the properties of classrooms. This proposal is based partly on the belief that teachers will use different instructional approaches with different classes of students. He discusses the ways in which these responses by teachers might occur depending on the students, and suggests that teachers may have individual patterns of adjustment that could be studied and defined in terms of their impact.

Monk's work provides a good review of what has been done in the area of productivity research in education and useful lenses for viewing the value of the work and possible directions for its development. He draws our attention particularly to weaknesses in the way in which the idea of educational process has been conceived. The study of productivity in education has been greatly hampered by underestimating the central role played by students in generating educational outcomes. A better understanding of productivity in education requires much more attention to what students think and what they do.

Students do not stand in relation to schools either as raw materials to be processed or as workers doing the processing. Education is a unique kind of production because it requires learners to create knowledge and meaning in the context of their own lives. The key aspect of social situations such as schooling, as has often been pointed out by theorists, is that humans are intentional; they can alter their actions according to their developing understanding of a given situation. This understanding is best captured in the phenomenological sociology of Alfred Schutz (1967, 1970), who wrote extensively about human intention and action and their development through a person's life experiences. Schutz's work, and that of others in the same vein (e.g., Natanson, 1970; Greene, 1988), illustrates the ways in which people make sense of their world, and how these relevancies shift constantly as their ideas and situations change.

The idea of a production function for education depends, of course, on seeing education as being a production process, which means that inputs are transformed into outputs in a standard way. The essential exemplar of a production relationship is the factory, in which raw materials are turned into finished products through various production processes. One can easily recognize the powerful role that the metaphor of the factory plays in much of the current policy conversation around schooling.

Many of the problems of production studies hinge on the role of students whether they are producers or materials. As soon as students are viewed as individuals with unique capacities and interests the problems of specifying a production relationship in schools become enormous, as Monk points out. Imagine a factory in which the raw materials had minds, and could make autonomous decisions about whether they would be part of whatever was being produced. Just as one was about to

weld a piece of metal to be the roof of a car the part that one had in hand would announce its unwillingness to play the assigned role and its desire instead to be part of an art gallery instead of being part of a car, or to become a piece of cloth instead of a piece of metal.

The idea of the student as worker seems more promising than that of the student as material to be worked on, since it acknowledges that learning is something that students do. In economic processes workers are doing something to some material or for someone else. Although students often do think of schooling in this sense, as doing something for their teachers or their parents, the concept of education is centrally concerned about what happens to learners, not what happens to others around them. If students are the workers, then they are working on themselves rather than on external materials.

Every teacher knows it. Every teacher realizes that what happens in a class is fundamentally dependent on who the students are, how they make sense of the world and what they want or do not want to do. Students are constantly making decisions about the amount of effort, attention and interest they will put into their school work. They decide to come to school or not, to pay attention in class or not, to take the material seriously or not, to focus on grades or not (Doyle, 1986). These decisions are not entirely independent of what schools and teachers do. Neither are they determined by what happens in schools. We may arrange schooling on the basis of relatively standard treatment of all while every educator recognizes that the best laid plans may come to nothing in the face of students with different agendas.

If what students do and think is central to education, then it must also be central to the way schooling is organized. Yet that is far from being the case. Most of the policy attention about schools focuses on such matters as curriculum, teachers, school organization, or governance. Policies in these areas are presumed, almost unthinkingly to yield changes in what students do, think, or learn.

Consider various sides of the debate over restructuring schooling. One approach has been what Fullan (1991) calls the "intensification" approach -- stricter curriculum requirements, closer supervision of teachers and students, external examinations, and so on. Here the assumption is that teachers and administrators will be tougher on students, and that students will respond to the changes by intensifying their own efforts at school. The strategy could be phrased as one of "making them learn whether they want to or not". Presumably we would already have taken steps to make sure all students learned what we wanted them to. As soon as we see students as both workers and product, clearly a strategy of intensification will not be successful, since it does not take into account the power and the range of students' ideas and the motivations.

The main alternative policy currently being proposed is the "professionalization" approach in which more authority is given to teachers to take the steps they see as most desirable. In some versions authority is moved to school communities which include teachers, parents, and sometimes students (Zeichner, 1992). But if we think of students as the central element, then this strategy seems unlikely to succeed. It assumes that teachers know what to do to create more learning, and that they will do so by giving them the authority. Neither assumption seems credible. It is reasonable to think that most teachers have a real concern about students and their welfare. It is not reasonable to think that all teachers have a tremendous store of knowledge about how to educate that they are waiting to unleash with dramatic effect as soon as they are freed from the shackles of bureaucratic restrictions.

Perhaps, we would need to pay much more attention to the issue of motivation. If students are the producers of their own learning, then their motivation is absolutely critical. There is a substantial literature on motivation, both in education and in psychology (Ames & Ames, 1984, 1989; Deci & Ryan, 1985; Hastings & Schwieso, 1987). Various strategies for the organization of schooling and teaching have been advanced based on this research. Nolen and Nicholls (2007), in reviewing the literature, come to the conclusion that the most effective strategies have to do with treating students as capable persons, capitalizing on their knowledge and interests, and involving students in determining goals and methods of learning. Berliner (1989) suggested that classrooms where different kinds of tasks are occurring simultaneously provide more ways for students to demonstrate ability and feel competent. DeCharms (1984), suggested that teachers need to provide students with choices and encourage "responsible pupil-influence attempts and independent activity", with students learning gradually to make more and larger choices.

6.4 Factors inhibiting Improvement in Productivity

Although the basic options for change are evident, there is increasing evidence that schools are remarkably resistant to change. One explanation for this resistance is the absence of adequate incentives. Pincus in his work (19…) "Incentives for Education in the Public Schools", offers six contrasts between schools and organization functioning in a competitive sphere. He notes that schools should be expected to:

a. Be more likely than the competitive firm to adopt cost-raising innovations since there is no marketplace to test the value of the innovation (e.g. smaller class size) in relation to its cost.

b. Be less likely than the competitive firm to adopt cost-reducing innovations unless the funds so saved become available for other purposes within the district.

c. Be less likely than the competitive firm to adopt innovations that significantly change the resource mix (e.g. a higher ratio of teacher aides to teachers, sharply increased use of capital-intensive technologies) because any consequent productivity increases are not necessarily matched by greater profits to the district and because replacement of labor by capital may threaten the guild structure of the schools.

d. Be more likely than the competitive firm to adopt new instructional processes or new wrinkles in administrative management that do not significantly change institutional structure.

e. Be less likely than the competitive firm to adopt innovations that change accustomed authority roles and established ways of doing business because changes in these relations represent the heaviest kind of real cost bureaucracies.

f. Be equally unwilling as competitive firms to face large-scale encroachments on protected markets (voucher systems, metropolitan are wide open enrollment), although for somewhat different reasons.

7. Productivity in Higher Education

Productivity in higher education is somewhat different from that in elementary and secondary education. Higher education and more specifically university, poses a number of characteristics that result in an organizational culture that makes pursuing productivity in a systematic way difficult.

Universities are stuffed by professionals with a tradition of autonomy. Unlike most other employees, professors maintain control over their own time. Control is further complicated by the fragmentation of university into academic departments. This decentralised structure creates problems at coordination and compliance.
In this setting any attempt to improve productivity outputs and outcomes needs to be realistic. The suggestions contain here focus on a practical institutional approach.

Although universities are understood to have three brand missions – teaching, research and public service – the focus in this part is teaching, especially undergraduate teaching. Universities are a classic example of a multiple output firm with additional outputs, including research, housing and entertainment (sports) to education. All of these activities are reflected in the measure of expenditures, but not measure in the price.

The university, it is increasingly argued, is the logical setting for developing and helping to implement the scientific and technological innovations demanded by a modern, complex and rational social system. As Schaffer (19…) argues, the rise of the technocratic norm of higher education is part of the historical process of "rationalization" which sociologist Max Weber viewed as transforming modern western society.

Faculties within these institutions have increasingly come under scrutiny themselves for how "productive" they are in providing technical answers to the concerns of everyday life. Assessment methods like prestige rankings and citation analysis as indicators of "scholarly productivity" are increasingly championed as legitimate ways to help college and university administrators evaluate faculty quality.

Academics working in public institutions of higher learning have historically heard, and recognized at least in principle, that the public was the ultimate beneficiary of their efforts. In the 1980s, however, many faculties have come to realize that the public expects specific and measurable outcomes for tax dollars invested in public institutions. The professoriate at most public institutions of higher learning today face an array of faculty assignments and distribution-of-effort forms rarely conceived of a generation ago.

Faculty members in both public and private research universities can easily recount their duties in the university. These include teaching, research, and often service. The assessment of teaching and service functions is usually straightforward; service by the number of hours spent in community activities consistent with the mission of the university, teaching by the number of hours spent in class and in preparation for it during the semester. Although both of these duties have themselves been the target of increased scrutiny during the past several decades, neither has proved to be a major stumbling block to basically mathematical methods of tracking faculty activity. A more difficult task, however, faces those administrators and scholars who desire increased knowledge about "scholarly productivity." Under the assumption that academic scholarship in the university is technically assessable, numerous attempts have been made to quantify this component of academic life. Dimensions of faculty quality, upon which several important studies were based, were investigated by scholars who themselves were well located in academic research departments.

The investigation of factors involved in academic scholarship can be and has been based on the scientific quest for understanding. Even in more conscientiously performed studies, unexamined assumptions, which thwart both the investigations attempted and conclusions reached, can be observed. One important study in the literature laid the groundwork thusly. Spurred especially by the scientific and

technological revolution of the 1960's a concern with increasing research productivity has generated a prodigious number of research studies on research. By and large, however, these inquiries have been directed to answering one question. What are the correlates of research? In addition, these studies have been limited by an over-reliance on a single measure of research productivity, namely, scholarly publications. The questions of how and why faculties go about pursuing their research interests have remained largely not investigated. (Pellino et al 1984)

The more general belief that the field of education is in essence, a scientific endeavour contains several conceptual weaknesses. One has to do with the assertion that the foundation of educational scholarship is to be located within the scientific enterprise. Another is that the fruits of scholarship are in some way related to school policy. The notion that scholarship must yield some type of product appears to be taken for granted. Neither of the first two of these assumptions is well documented in the literature of educational research and policy implementation. The last assumption typically is mistaken as proof that there are in fact unproductive academics.

It is conceivable that the assessment of the scientific nature of scholarly productivity within colleges of education might be done at the department level as opposed to the college as a whole. For example, several studies on scholarly productivity have found that educational psychologists typically dominate the ranks of the most productive and have more journals in which to be cited. This observation suggests that since educational psychologists are the "high priests" of the technological myth in college education, analysis of productivity among them might be meaningful. On the other hand, those whose scholarship is less tied to scientific claims or technological application may, by definition, be less "productive." There is no unanimous agreement that the social and behavioural sciences are the starting point in educational scholarship; thus when researchers find various departments overrepresented or underrepresented in objective profiles of scholarly productivity, what they are finding represents the diversity of orientations and interests within such colleges, not more or less productive faculty.

Analysis of scholarly productivity that focuses on the scientific nature of educational scholarship might be useful in assessing how scientific one's faculty is, but less useful in assessing the other forms of academic scholarship not dependent on some particular version of science.

Students entering a higher education institution exhibit certain characteristics and competencies. Evaluating the impact of university necessitated assessing changes resulting from the university environment, on the value added by a university. Any attempt to measure student outcomes is related to institutional goal-setting. Alexander Astin (1975) and his associates divide type of outcomes into cognitive and affective and type of data into behavioural and psychological as shown in Exhibit A.

		Type of Outcome	
		Cognitive	Affective
Type of Data	**Psychological**	Knowledge General Intelligence Critical- thinking ability Basic skills Special aptitudes Academic achievement	Self-concept Interests Values Attitudes Beliefs Drive for achievement Satisfaction with college

	Behavioral	Level of educational attainment	Choice of major career
		Vocational achievements:	Avocations
		Level of responsibility	Mental health
		income,	Citizenship
		Awards of special recognition	Interpersonal relations

Exhibit A. Taxonomy of student-outcome Measures

7.1 Showing Productivity Improvements.

After setting productivity objectives, defining productivity and measuring productivity, the next step is to demonstrate productivity improvements, which can be done in several ways. One is to show an increase in revenue or participation that derives from efforts that did not require an increase in tuition, fees, or taxes. Another is to show a significant increase in effectiveness, such as the employment rates of recent graduates, without increasing costs or using additional resources. Numerous measures are possible and each university should concentrate effort on those that best fit to its own circumstances.

7.2 Strategies to Increase Productivity

There is an abundant literature on possible strategies for increasing productivity in higher education, which can help universities to understand how they can reduce costs and increase student quality. Many of these strategies require changes in the administrative culture and the mindset of faculty and administrators. Attempts to implement these strategies may be met with resistance or even legal challenges from the various professional organizations and associations that support faculty and administrators.

Strategies for increasing productivity focus on improving the two key components of productivity that were defined earlier - effectiveness and efficiency. These strategies include privatization, decentralization, improving student quality, and increasing the flexibility of faculty.

a. Privatization

One way of increasing the cost-efficiency of higher education is through the privatization of certain services. Most universities are vertically integrated. While these services contribute to student learning, there is no reason why these services cannot be performed by private contractors.

When vertical integration exists, the full costs of inside staff, such as wages and benefits, may be accounted for in other budget or service categories, thus making it difficult to assess the full costs of a certain service. The fees charged by outside contractors, however, will more clearly represent the full cost of providing a particular service. In addition, competitive pressures will increase the likelihood that private contractors will provide an efficient quantity and quality of labor for each service.

b. Decentralization

Privatization is part of a larger strategy aimed at increasing productivity in higher education—the decentralization of the current administrative structure. While decentralization frequently occurs in the private sector, universities have generally not followed suit. Centralized administrative structures in universities have been criticized for several reasons. For one, administrators can generally add staff to meet their needs without having to justify the additions to anyone except other administrators.

Decentralization can result in several benefits for universities. First, academic departments will have more control over their costs and staffing needs. Departments will have more flexibility in aligning their resources to meet changes in student demands. Universities provide too little in the way of support staff for faculty, thus forcing faculty to perform clerical duties. If individual academic departments had more control over their own budgets, they might decide to replace a faculty position with several support staff to improve efficiency. At the same time, university administrators would have to resist the temptation to cut support staff in times of budget stringency. Creating a structure that gets the incentives right is not easy, but will be an essential feature of longer run reforms to improve efficiency.

c. Improving Student Quality

The quality of students—the knowledge and skills they gain from a university education—should be the primary goal of any institution of higher learning. However, just how to increase student quality remains unclear to many faculties. One reason for this lack of clarity is that many faculties, especially those at research institutions, see teaching as a secondary job responsibility behind publishing in academic journals and acquiring research grants. Another reason is that most faculty members do not have training in good teaching strategies.

Arthur Chickering and Zelda Gamson summarize good teaching practices in their article, "Seven Principles for Good Practices in Undergraduate Teaching."*(19)* These practices include encouraging student/faculty contact, encouraging active learning, encouraging cooperation among students, giving prompt feedback, communicating high expectations, encouraging more time on each task, and respecting diverse talents and ways of learning. An important point is that the current passive lecture format in most universities does not account for most of the practices just discussed. Even in smaller teaching-oriented colleges many of these practices are likely to be absent. And, there are huge new opportunities to employ new technologies such as the Internet to improve efficiency. For example, there is no reason for libraries to subscribe to statistical publications when the same data are readily available through the Internet.

d. Increased Flexibility of Faculty Staffing.

Instructional expenditures have historically accounted for nearly 35 percent of total university expenditures nationwide. Although universities spend roughly one-third of every dollar on instruction, different productivity concepts are appropriate for research and teaching functions. With respect to research, it is appropriate to measure productivity in terms of the quantity and quality of academic research and the amount of external funding acquired. With respect to teaching, it is appropriate to measure productivity by teaching loads and academic advising.

Much of the discussion relating to the role of faculty in contributing to productivity in higher education involves increasing the time that faculty spend in the classroom, enhancing the quality of instruction, and increased flexibility of faculty staffing. Given the expense of instruction relative to overall university expenditures, an important cost-saving and quality-enhancing strategy is to better align faculty with student needs. Currently, in many universities, as student demands for certain majors

or classes ebb and flow over time there is little change in the number of faculty in each department. A failure to match teaching capacity with student demand is completely opposite the private sector, where changes in business conditions directly influence staffing levels.

Several policies can increase the flexibility of faculty. But, arguably, the greatest obstacle to increased flexibility of faculty is tenure. An economic argument for tenure is that it saves initial expense on the part of the university. The saving arises because faculty with tenure, or those hired with the possibility of tenure, will work at a lower salary in return for the guarantee of lifetime employment. However, while there may be initial cost savings from tenure, the resulting inflexibility imposed by tenure has greater costs in terms of both dollars and student quality. Tenure prevents significant staffing changes in response to changes in student demands, and also may prevent lower quality faculty from being replaced by higher quality faculty.

Administrators and management professionals have suggested strategies that can increase faculty flexibility in the presence of tenure, although each of these strategies is not without problems. Some of these strategies may be met with opposition from faculty or even legal challenges. One strategy is to impose tenure quotas on the number or percentage of the faculty who may hold tenure at any one time.

e. The use of citation analysis to assess scholarly productivity

The current state of the art in the analysis of scholarly productivity, citation analysis, unfortunately provides a good illustration of this latter phenomenon. The conceptual difficulties besetting those who use this methodology are suggested by their entering focus as well as by their technique. John Smart provides an adequate working definition of this approach: "Citation analysis is a special form of bibliographic research used to assess the quality or importance of scientific contributions. This methodology is based on reference citations found in scientific publications and assumes that citation frequency data can be used to assess the significance of scientific contributions of individual scientists, academic departments, and scholarly journals."

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