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Measurement of Total Factor Productivity in Commercial Airlines Sector using Malmquist Index and Data Envelopment Model

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Abstract: ***This study attempts to measure productivity change of Airlines companies in private and public sector in India for a period of four years (2011-2016). In this study the nature and productivity change is probed using the Malmquist Productivity Index. This index has the constituents which are used to measure the performance in terms of change in Scale Efficiency, change in Technical Efficiency, change in Technological Change and Total Factor Productivity. The paper compares efficiencies for the companies in public and private commercial airlines sector in India. Five Airlines companies are included in the study. The research includes Total Annual Income as an output variable and Total Expenditure, Employee Compensation, Sales & Distribution Expenditure and Marketing expenses as Input variables. A panel data with 30 observations has been used for analysis. The panel data is used to arrive to MPI estimates, with a total of five commercial airlines companies in India. The Total Factor Productivity change in the airlines sector depends upon the change in the efficiency and productivity of the companies.***
From the study it is evident that the Total Factor Productivity change has not changed significantly over the last six years for all the companies under study. The Technical Efficiency was the highest in the year 2013-14 which then dropped in the subsequent year. The Total Factor Productivity change is mainly due to change in scale efficiency of the companies since the pure efficiency has shown no significant change during the period under study. The Total Factor Efficiency dropped by almost 50% in the case of Air India in the year 2015-16. This drop is attributed to the deterioration in the technical efficiency of the company. The overall Total Factor Productivity of Air India is the highest. This can be attributed to positive change in the company's Technical Efficiency especially in the year 2013-14.
It is evident that all the airlines companies under study have not emphasized on improving scale efficiency as well as pure efficiency. These companies can improve their overall productivity by bringing in efficiency in the scale of operations as well as focus on improving efficiency on factors other than scale of operations. The commercial airlines companies in India need to improve their scale efficiency and pure efficiency to improve their total factor productivity.

Keywords : Airlines sector; Malmquist Index; Efficiency Change; Technical Efficiency Change; Scale Efficiency Change; Pure Technical Efficiency Change; Total Productivity Change;

I. INTRODUCTION

Every organization can achieve its competitiveness by enhancing its productivity. In other words organization gets its competitive edge when it produces more value with same level of resources or produces same level of value using lesser resources. Productivity driven growth leads to the economic growth of the organization. Organizations can envisage productivity growth through efficient use of human and non-human resources. At the same time technology and knowledge can be used as catalyst for multiplying the growth in productivity.

II. AIRLINE INDUSTRY IN INDIA

Tata Airlines, India's first scheduled airlines, was started in 1932 by J. R. D. Tata. Later in 1945, Nizam of Hyderabad partnered Tata Sons to start Deccan Airways. In the next couple of years few airlines started operating in India viz. Airways India, Bharat Airways, Himalayan Aviation, Kalinga Air Lines etc. In 1953 almost 6 years after India's Independence Government of India nationalized and merged all the existing airlines in two state owned national carriers viz. Air India and Indian Airlines. Air India was intended for international travel while Indian Airlines was for domestic travel. Since then onwards, upto mid-nineties, these two airlines constituted Indian Airline industry and enjoyed full monopoly.

In mid 90s Government of India adopted the Liberalisation, Privatisation and Globalisation (LPG) Policy. And with this the country opened its aviation sector to new private airline operators. With the several new airlines started operating in India. Though airline industry is a highly capital intensive, still these new airlines were not started by big corporates of India but by small time entrepreneurs. The newly started airlines include included include Damania, East West, Jet, Sahara Modiluft, NPC and few more. Unfortunately many of these airlines could not continue their services because of huge losses they made. Some of the reasons for the losses are high fuel cost, route restrictions by Government and poor infrastructure. With the decline of Indian airline industry Indian Government did several changes to its aviation regulatory policy. Because of this a new era of Indian airline industry started form the year 2000 onwards. Air Deccan entered into the industry as a Low Cost Carrier (LCC).

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This was followed by other LLC viz. Spice Jet, Indigo and Go Air. New entrant Kingfisher Airline chose to be a luxurious Full Service Carrier (FCC) and competed with existing FSC Indian Airlines and Jet. Later Kingfisher Airlines acquired

Deccan and rechristened it as Kingfisher Express. As on date Kingfisher has stopped plying its services because huge debt and Jet Airways has made temporary suspension of its operations due to lack of cash since April, 2019. Air India is struggling with financial crisis. Indigo, Spice Jet and Go Air are performing well and many of them are making profits.

III. PRODUCTIVITY MEASUREMENT

Total Factor Productivity (TFP) measurement, which is defined as ratio of aggregate output produced in relation to cumulative inputs utilized to produce that output, is one of the effective tools of performance measurement. TFP is used to measure performance of a firm during a given period of time (Coelli et. al., 2005). It may also be used to measure the performance across various firms for a comparison. Earlier, organizations were achieving growth in productivity through efficiency improvement but today, growth in productivity is achieved by technological changes also. Thus productivity enhancement resulted because of efficiency improvement and technological developments. TFP measure the technological change and correlate it with the externalities and effects of scale (Jorgensen &Griliches, 1997). Other studies done by Law (2002) and Young (1992) presents the FTP measure the

There are two approaches for measuring TFP growth i.e. frontier approach and the non-frontier approach. In frontier approach the best obtainable position is estimated based on the estimation of the boundary function for a given set of inputs and outputs. The role of technical efficiency in the overall performance of the firm can be identified by frontier approach establishes the technical soundness of the firm.

IV. AIM OF THE STUDY

The main motive of the research is to measure and compare the technical efficiencies of selected airlines of India. This will result knowing which airline company is doing better in terms of technical efficiency while less efficient will understand the areas for further improvement. The no-parametric Data Envelop Analysis (DEA) technique is used to measure the technical efficiencies.

DEA is one of the popular approaches found in literature for productivity measurement. DEA is a linear programming methodology which is useful in case where it becomes difficulty to establish the relationship between the input and outputs, in such cases liners programming techniques is applied.

V. MATERIAL & METHODS

Efficiency can be defined on the assumption that output is maximized given certain inputs level and cost is minimized for a specified level of output (Kumbhakar and Lovell, 2000; Battese et al., 2000). There are three main types of efficiency based on economic theory: technical efficiency, allocative efficiency and cost efficiency. Basically, technical efficiency gives an idea on the effectiveness of a certain level of inputs used to generate an output. Allocative efficiency, on the other hand, refers to the involvement of choosing the mix of inputs in order to generate a specified level of outputs at the lowest cost (Battese et al., 2000). The combination of both technical and allocative efficiency is then known as cost efficiency (Assaf and Josiassen, 2012).

The relatively high fixed costs in the aviation industry and economies of scale have left a great impact on airlines efficiency (Spurling, 2009). In order to enhance the airline efficiency, it is extremely important that the airline companies take initiatives to maximize their employment and fleet utilization as well as to serve more passengers globally as to achieve load factor at the highest possible level. Based on the reviews of the literature, the economy of density (Vasigh et al., 2008), economy of scope (Ben, 2008), economies of scale (Button, 2010) and capacity utilization (Jara-Díaz et al., 2013) could have benefited airlines significantly in term of efficiency.

Barbot et al. (2008) have measured the productivity and efficiency of 41 international airlines. Labor (number of core business workers), fuel (in gallons consumed) and fleet (number of operating aircraft) were used as measures of inputs. RPK, ASK and revenue tonne kilometer (RTK), on the other hand, were used as measures of outputs. Productivity and efficiency comparison between low-cost carriers and full-service carriers was made in their research paper. DEA and TFP were the two methodologies used for the purpose of empirical analysis.

The research by Greer (2009) examined the technical efficiencies of US airlines with the application of DEA too. Greer transformed inputs such as fuel, fleet-wide seating capacity and labor into ASK. Instead of analyzing airline efficiency in developed countries, Hu et al. (2017) have turned their attention to Southeast Asia nations, the emerging markets. They measured and benchmarked the operational efficiency of 15 major airlines in ASEAN covering the period 2010-2014. Number of aircraft, operating cost and ASK were used as input measures; total revenue were the output variables in their research.

Our research paper includes Total Annual Income as an output variable and Total Expenditure, Employee Compensation, Sales & Distribution Expenditure and Marketing expenses as Input variables.

VI. RESULTS &DATA ANALYSIS

A panel data with 30 observations has been used for analysis. The panel data is used to arrive to MPI estimates, with a total of five commercial airlines companies in India. Table 1 depicts the descriptive statistics of the data used under study. The intercession approach is adopted, considering Total Expenditure, Employee Compensation, Sales & Distribution Expenditure and Marketing expenses as inputs, while Total Annual Income is considered as output.

Table 1: Descriptive Statistics

	Total Annual Income	Total Expenditure	Employee Compensation	Sales & Distribution Expenditure	Marketing expenses
Mean	2654472	3124233	354466.1	95243.9	94704.1
Std. Dev.	77495.89	95218.35	12607.14	3223.488	3236.551
Max	227932.7	265837.5	37514.9	9411.8	9411.8
Min	9418.8	10317.7	724.3	68.3	52.5

The DEA approach uses number of indices as alternatives for measuring the productivity changes. Fisher index, Tomqvist index and Malmquist index are some of the indexed used by some researchers while undertaking efficiency study. Since Malmquist index neither requires the profit maximization nor cost minimization assumption, many researchers prefer this index. The present study also uses Malmquist index to measure efficiency changes. Moreover, since this research uses panel data, this approach enables decomposition of productivity change into technological change and technical efficiency change.

VII. MEASUREMENT OF TOTAL FACTOR PRODUCTIVITY

This section measures Total Factor Productivity and its changes in years between 2011 and 2016. It also compares the Total Productivity and its changes between the commercial airlines companies. Balanced panel data with 30 observations that appear in five airlines companies are included in the study. The Malmquist productivity index has five constituents which are used for measuring the performance; these constituents include Technical Efficiency, Technological change Efficiency, Pure Technical Efficiency Change, change in Scale Efficiency and change in Total Factor Productivity.

The productivity within the segment is compared using the Malmquist productivity index. This gives the poor performers to compare themselves and identify scope for improvement. Total Factor Productivity refers to all factors pertain tothe operations/production of Airlines companies, or specifically changes in the efficiencies and changes in technology. It may be noted that when interpreting the results of Malmquist Total Factor Productivity, all components less than one indicate deterioration in the regression while component greater than one indicates improvement or progression. Component values equal to one indicates no improvement or deterioration in productivity.

A. Malmquist Index Summery of Annual Means

Table 2 : Efficiency Change for the period 2013 to 2016 in comparison with the previous year

MALMQUIST INDEX SUMMARY OF ANNUAL MEANS					
YEAR	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
2011-12	0.09	1.29	0.99	0.89	1.13
2012-13	1.12	0.75	1.01	1.10	0.85
2013-14	0.98	1.54	1.00	0.97	1.51
2014-15	1.01	0.99	0.99	1.02	1.00
2015-16	1.03	0.96	1.01	1.02	0.99
Mean	0.85	1.11	0.99	1.02	1.09
Change<1	3	3	2	2	2
Change>1	0	2	0	1	2
Change=1	2	0	3	2	1

Note : Efficiency Change (EFFCH), Technical Efficiency Change (TECHCH), Pure Technical Change (PECH), Scale efficiency Change (SECH), Total Factor Productivity Change (TFPCH)

It is evident from Table 2 that the efficiency of airlines companies was lowest during the year 2011-12. However there is positive efficiency change in the subsequent year 2012-13. The efficiency has been almost constant since then. The Technological Change Efficiency has deteriorated by 72% in the year 2012-13 which then significantly improved in the subsequent year 2013-14. It has been almost constant since then. The table indicates that there has been no significant change in pure efficiency as well as in the Scale efficiency during the period under study. From the Malmquist index it is evident that the Total Factor Productivity change has deteriorated in 2012-13 by 33% which almost doubled in the year 2013-14. This significant improvement in the Total Factor Productivity change can be attributed to the similar improvement in technical efficiency of airlines companies during the same period.

From the table it is evident that all the airlines companies under study have not emphasized on improving scale efficiency as well as pure efficiency. These companies can improve their overall productivity by bringing in efficiency in the scale of operations as well as focus on improving efficiency on factors other than scale of operations.

The individual mean productivity change of individual airlines companies is depicted in table 3

B. Malmquist Index Summery of Firm Means

Table 3: Efficiency Changes of individual Airlines companies

MALMQUIST INDEX SUMMARY OF FIRM MEANS					
YEAR	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
Air India	1.02	1.19	1.00	1.00	1.22
Go Airlines	1.00	1.02	1.00	1.00	1.02
Jet Airways.	0.99	1.01	1.00	0.99	1.01
Jet Lite	0.98	1.15	1.00	0.90	1.12
Spicejet	1.00	1.01	1.00	1.00	1.01
Mean	0.99	1.08	1.00	1.00	1.07
Change <1	2	0	0	2	0
Change>1	0	2	0	0	2
Change=1	3	3	5	3	3

Note : Efficiency Change (EFFCH), Technical Efficiency Change (TECHCH), Pure Technical Change (PECH), Scale efficiency Change (SECH), Total Factor Productivity Change (TFPCH) The Malmquist index summery of firm mean values indicates that there is no change in pure efficiency of any airlines company during the period under study. The Scale Efficiency is also almost constant with a marginal rise in case of Air India Ltd. and a marginal fall in case of both Jet Airways aswell as Jet Lite (India) Ltd.The Total Factor Productivity of Air India Ltd. is the highest followed by Jet Lite (India) Ltd. The Total Factor Productivity is constant for other commercial airlines companies under study.

C. Productivity Change Company wise

The following table depicts the efficiencies of company wise and year wise. The study of the table shall reveal the efficiency changes of each of the five commercial airlines under study during each of the year between 2011and 2016. This information helps in determining which airlines companies show superior performance and which companies have shown deterioration in their efficiency. Also it reflects the efficiency changes of each of the company for the last five years.

Table 4: Productivity Change Company wise

PRODUCIVITY CHANGE COMPANY WISE						
FIRM	**YEAR**	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
Air India Ltd.	2011-12	0.74	1.20	1.00	0.74	0.88
	2012-13	1.24	0.83	1.00	1.24	1.04
	2013-14	1.24	3.16	1.00	1.24	3.92
	2014-15	1.00	1.24	1.00	1.00	1.24
	2015-16	1.00	0.61	1.00	1.00	0.61
Mean		1.04	1.41	1.00	1.04	1.54
Go Airlines (India) Ltd.	2011-12	1.00	2.56	1.00	1.00	2.56
	2012-13	1.00	0.37	1.00	1.00	0.37
	2013-14	1.00	1.16	1.00	1.00	1.16
	2014-15	1.00	0.99	1.00	1.00	0.99
	2015-16	1.00	1.03	1.00	1.00	1.03
Mean		1.00	1.22	1.00	1.00	1.22
Jet Airways (India) Ltd.	2011-12	0.90	1.04	1.00	0.90	0.94
	2012-13	1.13	0.93	1.00	1.13	1.05
	2013-14	0.85	1.04	1.00	0.85	0.89
	2014-15	1.09	0.99	1.00	1.09	1.07
	2015-16	1.05	1.08	1.00	1.05	1.14
Mean		1.01	1.02	1.00	1.01	1.02
Jet Lite (India) Ltd. [Merged]	2011-12	0.96	1.10	1.00	0.96	1.06

	2012-13	1.04	0.92	1.00	1.04	0.96
	2013-14	1.00	2.12	1.00	1.00	2.12
	2014-15	0.90	0.85	1.00	0.90	0.77
	2015-16	1.01	1.10	1.00	1.01	1.11
Mean		0.98	1.22	1.00	0.98	1.20
Spicejet Ltd.	2011-12	0.83	1.03	0.94	0.88	0.85
	2012-13	1.21	0.92	1.06	1.14	1.11
	2013-14	0.83	1.10	1.00	0.83	0.92
	2014-15	1.07	0.97	0.95	1.13	1.04
	2015-16	1.10	1.09	1.05	1.07	1.23
Mean		1.008	1.022	1.001	1.009	1.028

Air India had the lowest efficiency in 2011-12 which the improved in the years 2012-13 and 2013-14. The efficiency has been constant since then. From the analysis it is clear that there is no significant change in the pure efficiency of Air India and therefore any change in the total factor productivity can be safely attributed to change in scale efficiency and technical efficiency. One can observe a significant jump in the total factor productivity of Air India in the year 2013-14 which is clearly due to the improvement in the technical efficiency of the company.

Go Air, on the other hand has shown no change in the efficiency as revelled from the Malmquist index. Both the pure efficiency as well as the scale sufficiency are constant. Any change, therefore in the Total Factor Productivity of Go Air can be attributed to Technical Change. The Total Factor Productivity of Go Air significantly dipped in the year 2012-13 which as per the analysis, is due to fall in technical efficiency of the company.

The Malmquist index shows that Pure Efficiency of Jet Airways (India) Ltd. is constant during the period of study. The technical efficiency is also not significantly changed although it saw a marginal dip in the years 2012-13 and 2014-15. The Total Factor Productivity is almost constant but shows a marginal fall during 2013-14.

In case of Jet Lite also the Pure Efficiency is constant. The Malmquist Index does not reveal any significant change in the Scale Efficiency either. The Total factor Productivity significantly increased due to remarkable increase in technical efficiency in the year 2013-14.

The Technical Efficiency of Spicejet Ltd. saw a dip of around 105 in the year 2012-13 and 2014-15. The Pure and Scale Efficiencies are almost constant with a marginal change of 8 to 10 % during the years 2011-12 and 2014-15. The Total Factor Productivity was the highest in the year 2015-16 mainly due to increase in scale efficiency.

VIII. DISCUSSION&CONCLUSION

From the research it is evident that the efficiency of the airlines companies was the lowest during 2011-12 which then improved due to improvement in the technical efficiency of these companies. No significant improvement in the scale and pure efficiency can be reason behind the stagnation of Total Factor Productivity of the airlines companies.

The overall Total Factor Productivity of Air India is the highest. This can be attributed to positive change in the company's Technical Efficiency especially in the year 2013-14. Go Airlines (India) Ltd., Spicejet Ltd. and Jet Airways (India) Ltd. have not shown any observable change in Total Factor Productivity, while Jet Lite (India) Ltd. has shown marginal improvement owing to enhanced Technical efficiency.

Jet Airways (India) Ltd flew its last flight on 17th April, 2019 from Amritsar to Mumbai after providing the emergency funds were rejected by the lenders. They were informed by the State Bank of India (SBI) that they were unable to consider its request for critical interim funding fearing its recovery in the future. Since no emergency funding from the lenders or any other source is forthcoming, the airline could not pay for fuel or other critical services to keep the operations going and stopped its operations temporarily since April 2019.

For the airline to make money it is very important to reduce the fuel prices in a price sensitive market like India. High costs and low yields is the situation of the Indian commercial airline industry. The commercial airlines companies in India need to improve their scale efficiency and pure efficiency to improve their total factor productivity.

REFERENCES

1. Aikaeli,J.A.(2008).CommercialbankefficiencyinTanzania.CSAEConferenceonEconomicDevelopmentinAfrica,St.Catherine'sCollege,Oxford.
2. Arora,V.&Singh,P.(2008).EconomicreformsandproductivitygrowthinIndianmanufacturingsector:An interstate analysis.TheIcfai UniversityJournal ofIndustrial Economics, 5(3), 35-47.
3. Battese GE, Heshmati A, and Hjalmarsson L (2000). Efficiency of labour use in the Swedish banking industry: A stochastic frontier approach. Empirical Economics, 25(4): 623-640.
4. Caves,D.W.,ChristensenL.R.andDiewertW.E.1982.TheEconomicTheoryofIndexNumbersandthe Measurement ofInput, Output, andProductivity.Econometrica 50(6), 1393–1414.
5. Charnes,A.,CooperW.& RhodesE.(1978).MeasuringtheEfficiencyofDecisionMakingUnits.Euro-pean Journal of OperationalResearch, 2: 429-444
6. Coelli,T.J,PrasadaRao,D.S.,O'DonnellC.J.andBatteseG.E.2005.AnIntroductiontoProductivityandEfficiencyAnalysis,Second Edition. USA: Springer.
7. Fare,R,Grosskopf,S&Roos,P(1998)'Malmquistproductivityindexes:asurveyoftheoryandpractice'inFare,R,Grosskopf,S&Russell,RR(eds)Index Numbers:Essays in HonorofStenMalmquistKluwerAcademicPublishers,Norwell,MA.PMid:9642777

8. Farrel,M.J.andFieldhouse,M.(1962)."EstimatingEfficientProductionFunctionsunderIncreasingReturns to Scale."Journal of the RoyalStatisticalSociety,SeriesA, 125, pp. 252-67.
9. Greer M (2009). Is it the labor unions' fault? Dissecting the causes of the impaired technical efficiencies of the legacy carriers in the United States. Transportation Research Part A: Policy and Practice, 43(9-10): 779-789.
10. GrifellTatjé,E.andLovell,C.A.K.(1995).ANoteontheMalmquistProductivityIndex,EconomicsLetters, 47 (2),pp. 169-175.
11. Griliches,1995.R&Dandproductivity:Econometricresultsandmeasurementissues.InHandbookoftheeconomicsofinnovationandtechnologicalchange,ed.P.Stone-man,52-89.Oxford,U.K.,andCambridge,
12. Heshmati A and Kim J (2016). Survey of studies on airlines and their efficiencies. In: Heshmati A and Kim J (Eds.), Efficiency and Competitiveness of International Airlines: 15-50. Springer, Singapore
13. Hu JL, Li Y, and Tung HJ (2017). Operational efficiency of ASEAN airlines: Based on DEA and bootstrapping approaches. Management Decision, 55(5): 957-986.
14. Jorgenson,D.W.,andGriliches.Z.1967.Theexplanationofproductivitychange.ReviewofEconomicStudies 34 (3):249-83.
15. Joshi,R.N.&Singh,S.P.(2010).Estimationoftotalfactorproductivityinthe Indiangarmentindustry.Journal of Fashion MarketingandManagement,14(1), 145-160.
16. Kathuria, V., Raj R.S.N., SenK. 2013. Productivity measurementin Indian manufacturing: A comparison of alternativemethods. Journal of QuantitativeEconomics,Vol. 11Nos.1&2(Combined).
17. Krugman,P.(1990),'IncreasingReturnsandEconomicGeography',NBERWorkingPapersNo.3275.
18. Krugman,P.(1994).TheMyth ofAsia'sMiracle,ForeignAffairs, 73, pp. 62-78
19. Krugman, Paul. 1996.The myth ofAsia'smiracle.PopInternationalism(Cambridge:MITPress).
20. Kumbhakar SC and Lovell CAK (2000). Stochastic frontier analysis. Cambridge University Press, Cambridge, UK
21. Law,MT.2000.Productivityandeconomicperformance:Anoverviewofth eissues.VancouverBC,TheFraserInstitute.
22. Lipsey, R.G, andCarlaw.K.I. 2002.Themeasurement of technologicalchange."unpublished.
23. Mahadevan,R. (2002).ADEAapproachtounderstanding the productivity growthof Malaysia'smanufacturingindustries.Asia Pacific Journal of Management, 19, 587–600.
24. Manjappa,D.H.&Mahesha,M.(2008).Measurementofproductivitygrowth,efficiencychangeandtechnicalprogressofselectedcapital-intensiveandlabourintensiveindustriesduringreformperiodinIndia.IndianJournal ofEconomicsandBusiness, 5 (4), 57-65.
25. Mawson,P.,K.I.CarlawandN.McLellan(2003),"ProductivityMeasurement:AlternativeApproachesandEstimates",NewZealandTreasury,Working Paper 03/12.
26. Metcalf,S.1987.Technicalchange.inEatwelletaledTheNewPalgrave,aDictionaryofEconomics(London:MacMillan.).
27. Spurling DJ (2009). Introduction to transport economics: Demand, cost, pricing, and adoption. Universal-Publishers, Boca Raton, USA.
28. Worthington, A. (1999). MalmquistIndicesof Productivity Change in Australian.Journal ofInternationalFinancialMarkets,Institutions and Money, 9(3),303-320
29. Young,A.(1995).TheTyrannyofNumbers:ConfrontingtheStatisticalRealitiesoftheEast Asian GrowthExperience,QuarterlyJournal of Economics, 110(3), pp.641-80.
30. Young,A.1992.Ataleoftwocities:FactoraccumulationandtechnicalChange.NBERMacroeconomicAnnual(Cambridge: MITPress).