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Sustainable Development through Workforce Planning: An Analysis and Forecast of Investment-Based Employment Generation

P.T. Dammage[a], V.M. Wickramasinghe [b1] , T.M.J.A. Cooray [c]

[a]*National Institute of Technical Education of Sri Lanka, Sri Lanka*
[b]*Department of Management of Technology, University of Moratuwa, Sri Lanka*
[c]*Department of Mathematics, University of Moratuwa,, Sri Lanka*

Abstract

This paper proposes a method for analysing the relationship between investment and employment generation as well as a method for forecasting employment generation for a future period based on past investment and employment data. Two classes of data streams, at micro and macro levels of the country were used to illustrate the proposed methodology. At the macro level, national level investment and employment generation data were taken into account, while at micro level investment and employment generation data of three export processing zones (EPZs) – Katunayeka, Biyagama, and Koggala, were taken into account. An indicator named "Employment Creation per Investment" was developed for the study. The data was collected from Central Bank of Sri Lanka and Board of Investment of Sri Lanka since 1985 on investment and employment generation. The methodology proposed in this paper could be applied to any industry, sector or country.

Keywords: Workforce Planning, Forecasting, Investment, Workforce Demand, Employment Creation

1. Introduction

Workforce planning is a process of identifying the quantity and quality of employees required to achieve strategic goals and objectives, ensuring that the right number of people is in the right jobs at the right time. At the national level, a well-planned human resource is seen as the foundation for economic growth, where human resource plans provide a picture of current workforce and gaps between current and the required skills to perform work during a future given period (Buchan 2004; Campbell, 1997; Clarke & Carr-Hill, 2001; Gill, 1996). Such information is valuable in maintaining a diversified workforce and preparing plans for expansions and restructuring of the workforce

[1]Corresponding Author: vathsala@mot.mrt.ac.lk

(Maynard, 2006; O'Brien-Pallas, Birch, Baumann, & Murphy, 2001). However, workforce planning for a sustainable economic development has become one of the challenges faced by nations today.

For effective workforce planning, the foundation is the identification of demand for labour, which could be estimated by a systematic forecasting of the workforce based on investment. In other words, there is a relationship between investment and employment creation of a country. Based on past data, possible investments for a given future timeframe could be forecasted. At the same time, for a given investment, possible employment generation could be forecasted. Then, measures could be taken to address workforce surplus or shortage. Hence, challenges poised by workforce requirements for future time periods cannot be overcome with ad-hoc planning; it demands a proper analysis with a greater insight (Berzinskiene, 2005; Shipman, Lurie, & Goodmand, 2004). Employment generation under a given investment scenario with related analysis should be brought forward through a proper study. Though forecasting quantity and quality of human resource based on a model is essential, up to date, no study has been carried out to analyse and estimate workforce requirements in Sri Lanka. This study is an attempt to address this research gap.

The main purpose of this research was to analyse investment and employment generation data of Sri Lanka and to forecast national level workforce demand based on past investment and employment generation data for the years 2008 to 2011. The specific objectives of the research were: a) To develop a methodology to analyse the number of job opportunities created for each past year based on each past year's investment, since 1985, b) To develop a methodology to forecast the number of future job opportunities that would be generated for the years 2008 to 2011 based on investment. It is expected that the findings of the study will have broader relevance at the national level policy planning. Further, the methodology proposed in this paper could be applied to any industry, sector or country.

2. Theoretical Background

As a part of national level human resource management, workforce planning is concerned with planning for a healthy workforce having the right mix of people and skills to achieve current objectives and meet future challenges. Workforce planning enables to better respond to ever changing economic environment, and results in the efficient use of the most valuable resource: its people. Hence, workforce planning will keep governments informed about the structure and characteristics of the workforce and also future workforce requirements in terms of skills and experience (Bartlett, Johnson & Schneider, 2006; Gill, 1996; Thompson, 2003). In this regard, economic development and employment of a country are areas that extend across both government sector and private sector where strong partnerships is required among government institutions, non-government organizations, industry groups, employment services, training providers and communities. Such a partnership will contribute to the development of policies and programmes that will enable government sector and private sectors to realise their goals in the most optimal manner (Hamilton et al., 2000; Jayaraman & Singh, 2007; Millsteed, 1999).

Realistic forecasting of workforce involves estimating both supply and demand. The people in the labour force are the suppliers of labour. Normally, the labour force consists of everyone of working age (typically above a certain age around 14 to 16) and below retirement (around 65) who are actively employed or seeking employment. People not counted include students, retired people, and stay-at-home parents, people in prisons or similar institutions, as well as discouraged workers who cannot find work (Walker, 2002). Analysis of workforce supply focuses on the specifics of the existing

workforce and projects future workforce supply. Therefore, with regard to supply side of the workforce, it is important to identify workforce diversity information such as age, gender, the level of education and the length of service; the existing skill profile of the workforce; salary and other workforce expenditure data; workforce management issues that affect internal labour market, for example workforce capabilities in terms of high, average and poor performers; and turnover, promotion, and retirement patterns (Ekamper, 1997; Chan et al., 2005). Such information is useful to make projections on the number and capabilities of the existing workforce without hiring replacements for the future (Keel, 2006). Especially, a trend analysis helps to project how the variables listed above will influence the future supply of workforce (Thompson, 2003; Biviano et al., 2004).

Analysis of workforce demand identifies the quantity and quality of workforce needed to accomplish future development plans (Keel, 2006). The main questions to be answered include how technology will influence future workforce demand, jobs that will be affected by technological enhancements, whether any changes in technology will affect the number of employees needed to do the work or the type of skills needed, and demographic issues that are likely to influence the workforce demand (Chan et al., 2005; Goldstein, 2004; Maynard, 2006). Such information has a significant impact on preparing the size and the kind of workforce that will be needed in the future (Glyn, 2005; Haddadj & Besson, 1998; Harvey et al., 1999; Karanassou et al., 2007). In workforce forecasting, techniques such as time series analysis, regression analysis, and econometric methods are being applied, depending on the situation (Glyn et al. 2005; Hall, 1996).

Though the demand for workforce should be forecasted in order to manage the supply side of workforce, considerable attention of the past research studies were on supply side forecasting; only few attempts were directed at demand side forecasting. However, due to the heterogeneous character of the labour market and a range of inflexibilities of both supply and demand, the labour market could suffer serious mismatch phenomena. While some employees face unemployment, firms may have recruitment problems for various skill categories. Therefore, public policies should address the ways of coordinating the educational system on the one hand, which largely determines the skills supplied, and on the other hand, the demand for various skill categories (Ekamper, 1997; Hurst, 2006; Walker, 2002).

Gap analysis is the process of comparing the workforce supply projection to the workforce demand projection (Geerlings et al., 2001). Gap analysis focuses on the composition of the workforce, including demographic characteristics, geographic location, size, and employee skill levels. Such an analysis could reveal either shortage or surplus in workforce supply. A shortage, where forecasted supply is less than forecasted demand indicates a future shortage of needed workforce while a surplus, where forecasted supply is greater than forecasted demand, indicates a future excess in some categories of workforce. Surplus leads to unemployment while shortage leads to failure in implementing plans at micro or macro levels. If there is a shortage or surplus in workforce supply, it is difficult to achieve development plans of an industry, sector, or country. Hence, both surplus and shortage situations eventually urge action (Haddadj & Besson, 1998; Hall, 1986; Hamilton et al., 2000; Weiner, 2002; Williams, 1998).

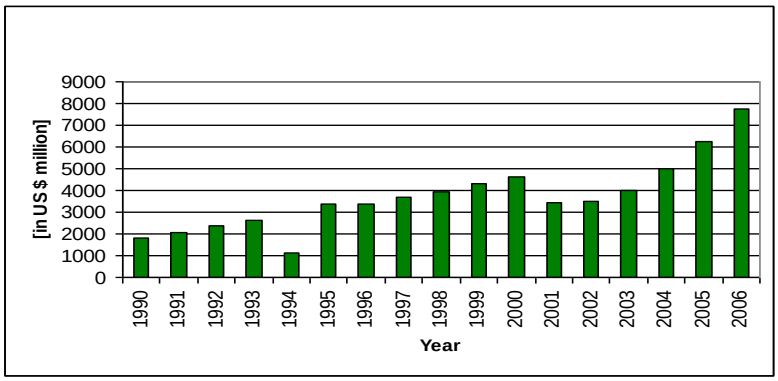
Though in the past gap analysis is confined to calculating the gap between workforce supply and demand, workforce planning is now considered as a far more sophisticated process that enables to adjust and respond quickly to immediate and future requirements. For example, gap analysis today

provides information on future workforce requirements (headcount), where shortages and surpluses exist (by designated job families), the areas of vulnerability that could adversely impact upon the future plans, the impact of generational change have upon workforce composition, and the types of new skills and competencies required from the workforce (Bredgaard et al., 2005; Ekamper, 1994). Therefore, properly designed and executed workforce-forecasts provide important information that is vital to the accomplishment of future development plans of any industry, sector, or country.

3. Sri Lankan Context

The secondary data on workforce availability and employment opportunities generated with respective investment provide a broader picture of the current workforce situation. This information is valuable in analysing workforce supply and demand. However, the secondary data available in Sri Lanka does not provide adequate information about the workforce to make strategic decisions. For example, Figure 1 and Figure 2 show the plot of past data on total investment and total employment generated for the corresponding years, respectively.

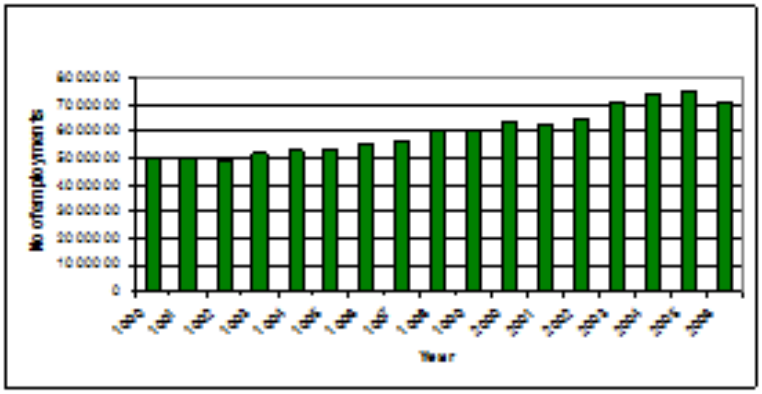
Figure 1: Total Investment in Sri Lanka 1990-2006



Source: Central Bank of Sri Lanka, 2006

When the total investment of the year 2002 is considered, the breakdown of investment by sector is- 34.5% Agriculture and fisheries, 16.5% Manufacturing, 4.4% Construction, 14.7% Trade and hotels, 4.7% Transport and communication, 2.6% Finance and insurance, and 22.7% personnel services (Central Bank of Sri Lanka, 2002). Accordingly, the picture suggests by Figure 2 is also blurred. Therefore, the scenario presented in Figure1 and Figure 2 does not provide much detail on industry level features and issues. Hence, the development of a model for investment based workforce planning is essential to analyse the relationship between investment and employment generation as well as for forecasting employment generation for a future period based on past investment and employment data.

Figure 2: Total Employment in Sri Lanka 1990-2006



Source: Central Bank of Sri Lanka, 2006

The preliminary investigations made by the authors revealed that there is no central database in the country that specifies the existing workforce details, investment, employment opportunities generated by sector-wise or industry-wise to be used to accomplish the objectives set for the study. However, authors were able to identify that Board of Investment of Sri Lanka (BOI) maintain barely sufficient information on BOI initiated projects. Therefore, it was decided to mainly rely on BOI data to conduct the research. The following section gives a brief description of the investment and employment generation in BOI initiated projects.

3.1 BOI Initiated Investment Projects and Employment Opportunities Created

The BOI has facilitated the setting up of commercial ventures within Export Processing Zones (EPZs), outside EPZs, under the two hundred garment factory programme and fifty garment factory programme. Since its inception BOI has contributed significantly to the economic development of the country through increased inflow of foreign direct investment, increased exports, and increased employment opportunities by opening up linkages with the global economy (BOI, 2006).

Primary objectives of setting up EPZs are to promote export-led industrial development through the infusion of foreign investment, to transfer modern state-of-art technology to the country, and to utilise and enhance workforce capabilities. EPZs also provide employment opportunities to country's expanding workforce. The EPZ model has played an important role in the export-oriented investment strategy pursued by successive governments in Sri Lanka since 1977. A notable change in establishing EPZs in the country during the recent past is the construction of several small and medium scale EPZs throughout the country that accommodate about 15-30 enterprises in designated locations (BOI, 1996). This policy decision was taken by BOI to avoid social and infrastructure bottlenecks inherent in large EPZs.

Table 1 gives a brief description of EPZs implemented and managed by BOI. Table 2 shows the investment and employment generation data of all EPZs until 2006.

Table 1: EPZs in Sri Lanka

EPZ	District	Year of Establishment	Total Extent (Ha.)	Number of Enterprises
(1) Katunayake	Gampaha	1978	190	103
(2) Biyagama	Gampaha	1985	180	62
(3) Koggala	Galle	1991	80	32
(4) Kandy	Kandy	1994	83	12
(5) Malwatte	Gampaha	1998	25	6
(6) Mirigama	Gampaha	1998	107	14
(7) Mawathagama	Gampaha	1999	20	20
(8) Polgahawela	Kurunagala	1999	20	43
(9) Wathupitiwala	Gampaha	1999	27	Definite figures not available
(10) Seethawaka	Colombo	1999	168	Definite figures not available
(11) Horana	Kalutara	2000	20	Definite figures not available
(12) Mirijjawala	Hambantota	2000	08	Definite figures not available

Source: BOI, Sri Lanka (2006)

Table 2: Investment and Employment Generation in EPZs

Year	Investment in US $(Million)	Direct employment opportunities
1995	219	85847
1996	245	86906
1997	272	90700
1998	288	91404
1999	301	100578
2000	313	109532
2001	291	110368
2002	333	109994
2003	351	114938
2004	458	114249
2005	466	110377
2006	525	97306

Source: BOI, Sri Lanka (2006)

4. Methods

Data was sourced from the Central Bank of Sri Lanka as well as the BOI and used to construct an indicator to model the relationship between past investment and past employment generation. This in turn was used to forecast employment generation, based on forecasted investments

4.1 Sources of Data

Table 3 shows the details of the data used for the analysis in this paper. The EPZ level analysis was confined to three zones.

Table 3: Details of Data Used for the Analysis

Data Category	Details	Duration	Source
National level	Total investment and direct employment opportunities created	1995-2006	Central Bank of Sri Lanka
Total EPZ as single entity	Total investment, direct employment opportunities created and the number of firms in operation	1985-2006	BOI
Katunayeka EPZ	Total investment, direct employment opportunities created and the number of firms in operation	1985-2006	BOI
Biyagama EPZ	Total investment, direct employment opportunities created and the number of firms in operation	1985-2006	BOI
Koggala EPZ	Total investment, direct employment opportunities created and the number of firms in operation	1992-2006	BOI
Industrial sector-wise (BOI only)	Total investment and direct employment opportunities created	1985-2006	BOI

United States Dollar conversion rate was used as given by Central Bank of Sri Lanka for that respective year. As the United States Dollar used by BOI is the same as the rate used by Central Bank of Sri Lanka, the conversion rates that were used in this study have no contradictory against both institutes.

Investment is defined as the total project cost, funded by equity and debt. Networking capital financing should not exceed three months. Cost of land should not exceed 25% of the investment in the case of property development. The minimum equity investment required from each foreign national or entity is US$ 250,000 (BOI, 2006).

4.2 Methods of Data Analysis

In the study, a model was developed to forecast workforce for the years 2008 to 2011 based on the investment and employment generation data of the years 1985 to 2006.

Employment Creation per Investment

In the industrial sector, employment generation depends on the investment made under a particular project. The indicator developed to model the relationship between past investment and past employment generation is called Employment Creation per Investment (ECI), which shows the number of jobs created per 1 Million US Dollars invested in each past year. The ECI was developed based on past investment and employment generation data obtained for the period of 1985 to 2006, and then used to forecast the workforce for the years 2008 to 2011. ECI is defined as:

$$ECI = \frac{\sum_{n=1}^{n=Total} (Jobs)}{\sum_{n=1}^{n=Total} (Investment)}$$

Where n is the selected sub category number in a selected segment. For instance, the segment can be considered as one EPZ. Sub categories will be the industrial projects coming under that particular EPZ. When the values of past investment and the number of direct employment opportunities are known, employment creation per investment can be estimated using this indicator.

When investment for each year is not uniform, ECI for each year take different values. To overcome this difficulty in forecasting future employment creations, average ECI for a particular period of years has been calculated, where, P is the number of years and i is the selected segment:

$$Mean = \frac{\sum_{m=1}^{m=P} [ECI]_i}{P}$$

ECI values were calculated for Sri Lanka as a single entity, all EPZs as a single entity, Katunayake EPZ, Biyagama EPZ, Koggala EPZ, industrial sector as a single entity, and for one selected industrial sector, i.e., Food, Beverage and Tobacco. BOI identifies nine industrial sectors, namely, Food, Beverage and Tobacco; Textiles, Wearing Apparel and Leather Production; Wood and Wood Products; Paper, Paper Products, Printing and Publishing; Chemicals, Petroleum, Coal, Rubber and Plastics; Non-Metallic Mineral Products; Fabricated Metal, Machinery and Transport Equipment; Other Manufactured Products; and Services (including Agriculture).

Model of Best Fit

It is a common practice to "fit a line" to a set of data in order to determine some useful parameters in a mathematical model or perhaps to generate a calibration curve. A straight line is a simple polynomial and goal of the fit is to determine the coefficients (the slope and intercept) of the polynomial that lead to the "best fit" of a line to the data. However, when the data is nonlinear, it needs higher order modelling. The fitting process can be generalised to determine the coefficients of a higher order polynomial that best fits the data points. In this research, first order (Linear) and second order (Quadratic) models were analysed.

First order (Linear) polynomial is defined as:

$$Y = a + bt$$

Where t is the time and y is the model output. Here, a and b give the coefficients of the model fitted with the data.

The second order (Quadratic), polynomial is defined as:

$$Y = a + bt + ct^2$$

Where a, b and c denote the coefficients of the quadratic model fitted with the data.

Exponential smoothing technique was used for forecasting, which is given below. This method has become popular and found to be quite effective. These forecasts were based on assumption that the parameters did not change over the time.

Next Period Forecast = Weight x (Present Period Observation) + (1 - Weight) x (Present Period Forecast)

5. Data Analysis and Findings

This section will begin with an evaluation of investment and employment generation in the period 1995–2006, followed by a forecast for the period 2008–2011.

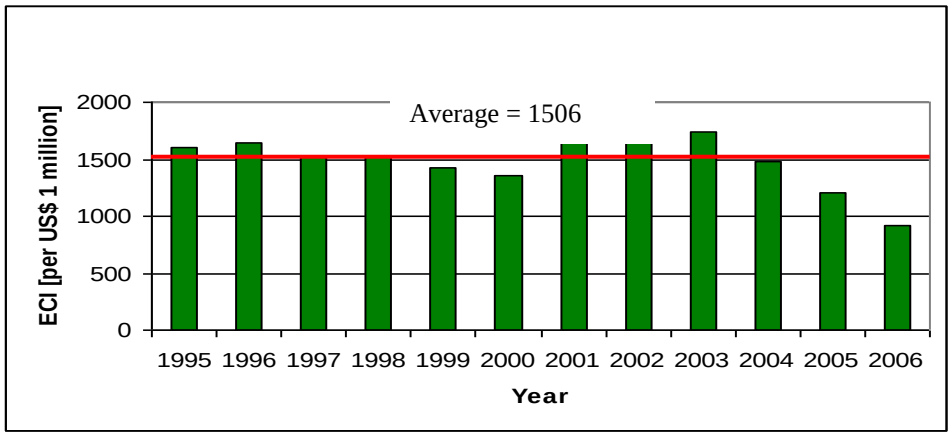
5.1 Evaluation of Investment and Employment Generation from 1995 to 2006

ECI values are calculated to evaluate investment and employment data. The results are summarised below.

National Level

Figure 3 shows the ECI values and average ECI for Sri Lanka. The average number of employment opportunities generated per 1 Million US Dollars is 1506.

Figure 3: Employment Creation per Investment US $ 1 million in Sri Lanka



EPZs as a Single Entity

Table 4 shows the investment and employment data of all EPZs as a single entity. The average value of ECI is 316.

Figure 4(a) shows the total number of firms in operation in EPZs from 1995 to 2006. Overall, it could be noted that there is a gradual increase in the number of total firms in operation. Figure 4(b) shows the plot of past data of the amount of investment in EPZs from 1995 to 2006. Figure 4(c) shows the employment creation per investment in EPZs.

Table 4: ECI for all EPZ

Year	Investment in US $(Million)	Direct Employment Opportunities	ECI
1995	219	85847	391
1996	245	86906	355
1997	272	90700	333
1998	288	91404	317
1999	301	100578	334
2000	313	109532	350
2001	291	110368	379
2002	333	109994	331
2003	351	114938	328
2004	458	114249	249
2005	466	110377	237
2006	525	97306	185
Mean	338	101850	316

Figure 4(a): Total Firms in EPZs

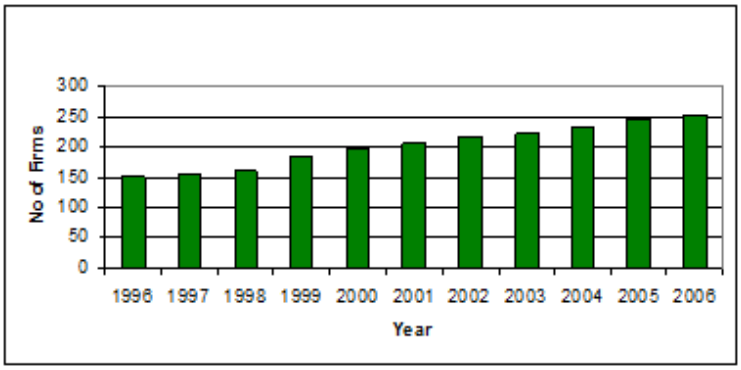


Figure 4(b): Total Investment in EPZ

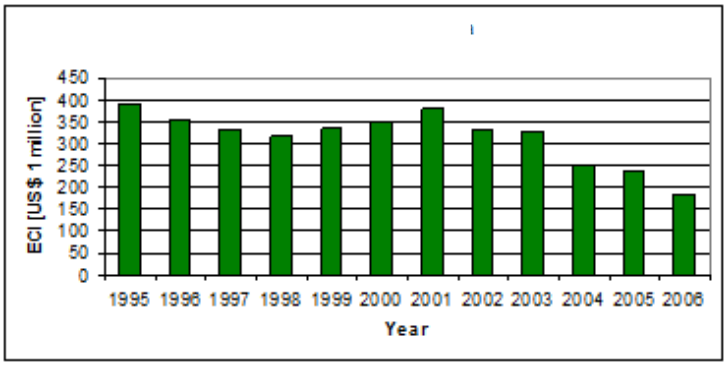
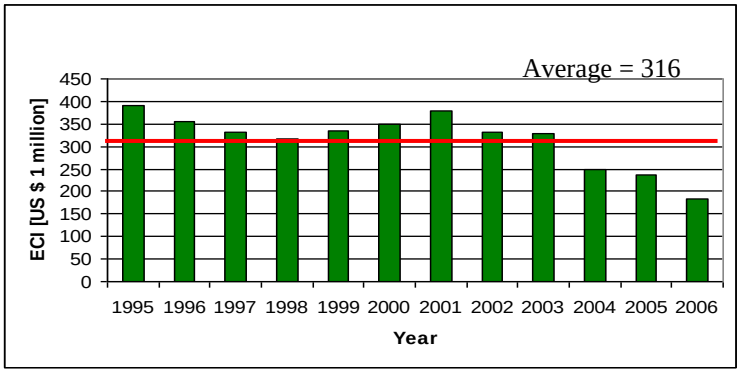


Figure 4(c): Employment Creation per Investment US $ 1 Million in EPZs



Although there is an increase in the total number of firms in operation in EPZs and the amount of investment since 2004, it is apparent that the number of employment opportunities created per investment (ECI) has gradually decreased (see Table 4, Figure 3a, 3b, and 3c). Further investigations revealed that the majority of firms tend to bring more machine intensive production technologies than ever or update existing production plants to accommodate advanced technology. Therefore, although more employment opportunities were generated in the early years, in recent years employment generation has declined, Therefore, ECI value is less in 2006 compared to 1995 (for a US $ 1 Million investment); in 1995, 391 employment opportunities were generated whereas in 2006, 185 employment opportunities were generated. This should be expected with the modern automations as it reduces the human labour component.

Katunayake EPZ

Table 5 shows investment and employment data of Katunayake EPZ. The average value of ECI is 468. The investment and employment generation data of Katunayake EPZ is important as it is the first EPZ established in Sri Lanka. Figure 5(a), 5(b) and 5(c) show the total number of firms in operation, investment and ECI for Katunayake EPZ, respectively.

Table 5: ECI Calculation for Katunayake EPZ

Year	Investment in US $(Million)	Direct employment opportunities	ECI
1995	122	59495	488
1996	129	59027	458
1997	136	60400	443
1998	139	59607	430
1999	140	59143	422
2000	142	63290	445
2001	109	61570	566
2002	102	55909	548
2003	82	58259	711
2004	118	57569	487
2005	155	53984	348
2006	193	51292	264
Mean	131	58295	468

Figure 5(a): Total Firms in Katunayake EPZ

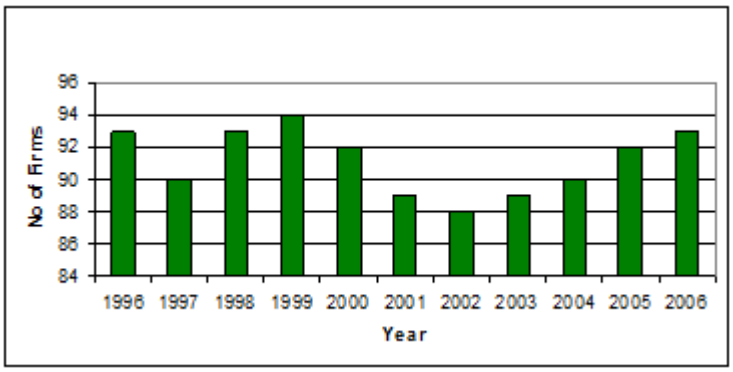


Figure 5(b): Total Investment in Katunayake EPZ

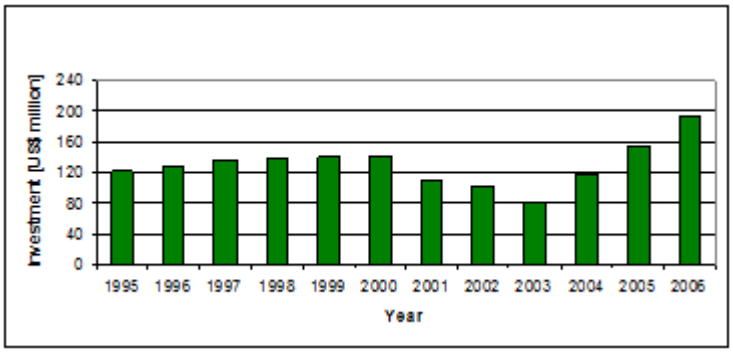
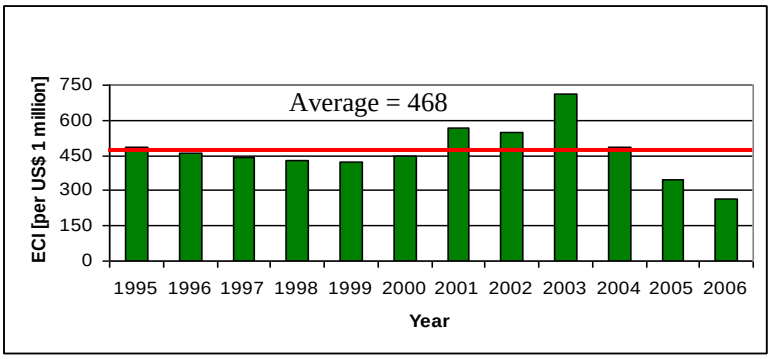


Figure 5(c): Employment Creation per Investment US $ 1 million in Katunayake EPZ



The observations that could be made with regard to the number of firms, the amount of investment and ECI are not much different than the observations made under EPZs, except the changes that are apparent in year 2003. According to BOI reports, new employment opportunities were created in Katunayake EPZ in 2003 under newly introduced "50 garment factory programme". Further, according to BOI reports, those factories were instructed to utilise more human capital rather than automatic or semi-automatic machines. This is the most likely explanation for the high ECI value in 2003 compared to previous years.

Biyagama EPZ

Table 6 shows the investment and employment data of Biyagama EPZ. The average value of ECI is 204. The investment and employment generation data of Biyagama EPZ is important as it is hosting the highest number of machine intensive factories and accounts for the lowest ECI values compared to any other EPZ in Sri Lanka. Figure 6(a), 6(b) and 6(c) show the total number of firms in operation, investment and ECI for Biyagama EPZ, respectively.

Table 6: ECI Calculation for Biyagama EPZ

Year	Investment in US $(Million)	Direct employment opportunities	ECI
1995	93	21085	227
1996	111	22165	200
1997	114	24400	214
1998	113	24997	221
1999	112	25652	229
2000	112	29017	260
2001	99	28336	285
2002	107	27251	254
2003	137	28914	211
2004	183	27129	148
2005	188	19801	106
2006	216	19391	89
Mean	132	24845	204

Figure 6(a): Total Firms in Biyagama EPZ

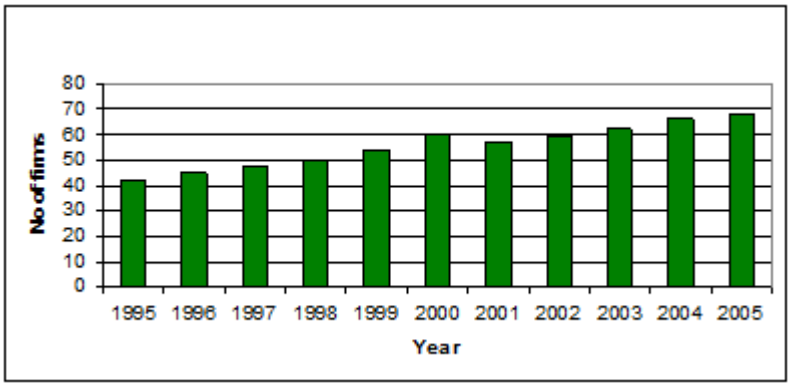


Figure 6(b): Total Investment in Biyagama EPZ

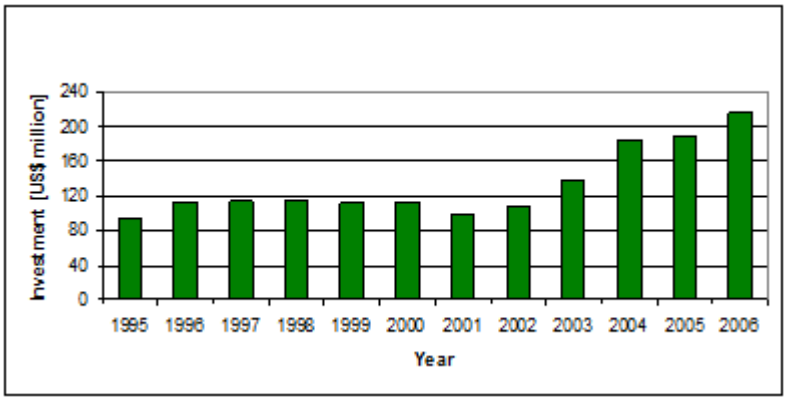
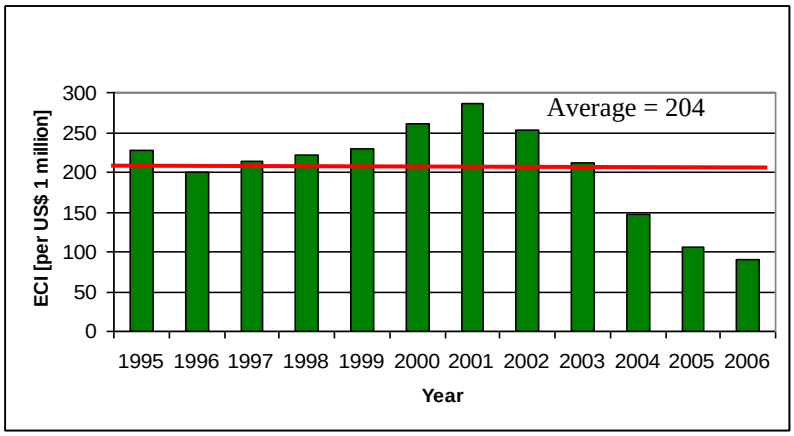


Figure: 6(c): Employment Creation per Investment US $ 1 million in Biyagama EPZ



Although there is an increase in the total number of firms in operation in Biyagama EPZ and the amount of investment increased since 1995, it is apparent that ECI has gradually decreased (see Table 6, Figure 5a, 5b, and 5c). Year 2002 accounts for the highest ECI. BOI records led to identify that several firms with more human capital component compared to any other years have commenced business operations in the year 2002. However, from 2002, ECI has gradually decreased. ECI value is less in 2006 compared to 1995. This should be expected with the modern automations as it reduces the human labour component. It should be further noted that Biyagama EPZ has the lowest ECI values among all EPZs in Sri Lanka. An analysis of BOI records led to identify that Biyagama EPZ is hosting the highest number of machine intensive factories than any other EPZ.

Koggala EPZ

Table 7 shows investment and employment data of Koggala EPZ. The average value of ECI is 811. The investment and employment generation data of Koggala EPZ is important as it hosts the fewest number of firms, but accounts for the highest number of labour intensive factories and the highest ECI values compared to any other EPZ in Sri Lanka. Figure 7(a), 7(b) and 7(c) show the total number of firms in operation, investment and ECI for Koggala EPZ, respectively.

Table 7: ECI Calculation for Koggala EPZ

Year	Investment in US $ (Million)	Direct employment opportunities	ECI
1995	5	5267	1105
1996	5	5714	1237
1997	6	5900	925
1998	8	6800	883
1999	9	7985	909
2000	10	5435	557
2001	6	4686	749
2002	12	5958	517
2003	9	5860	653
2004	11	7638	674
2005	15	12334	809
2006	14	9587	716
Mean	9	6930	811

An analysis of BOI records revealed that Koggala EPZ is hosting the fewest number of firms among the EPZs. However, these firms account for the highest number of labour intensive factories among all EPZs.

Figure 7(a): Total Firms in Koggala EPZ

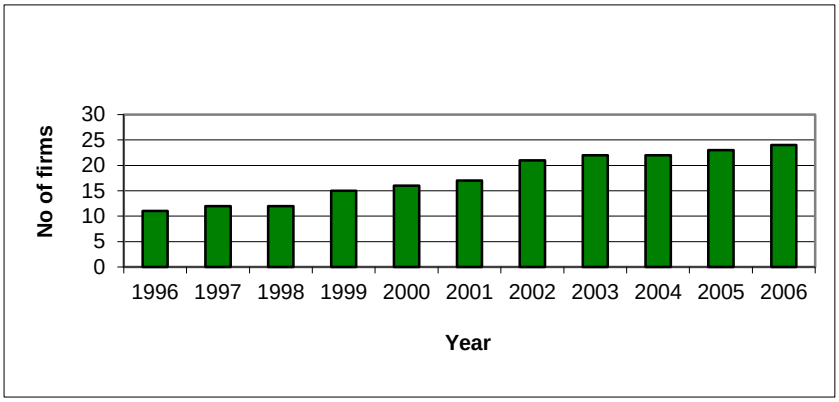


Figure 7(b): Total Investment in Koggala EPZ

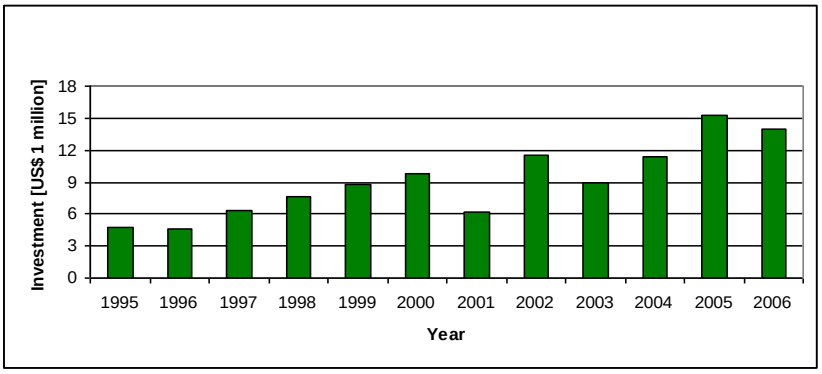
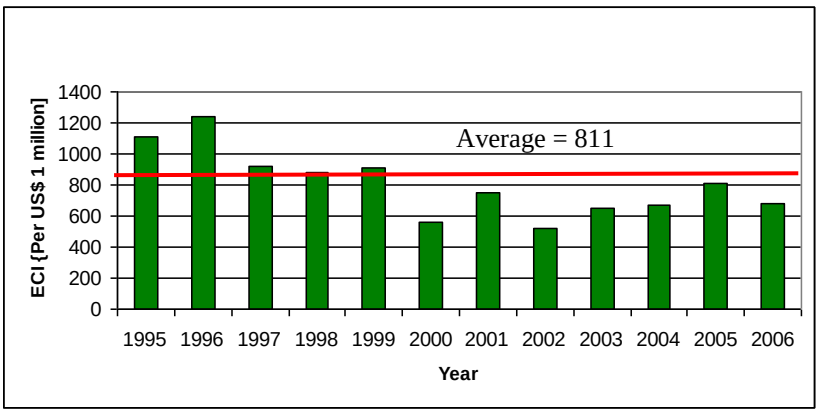


Figure 7(c): Employment Creation per Investment US $ 1 million in Koggala EPZ



Industrial Sectors

Table 8 shows the average ECI values for the nine industrial sectors that come under BOI.

Table 8: ECI Calculation for Industrial Sectors

Sector	Average ECI
Food, Beverage and Tobacco	256
Textiles, Wearing Apparel and Leather Production	618
Wood and Wood Products	347
Paper, Paper Product, Printing and Publishing	76
Chemicals, Petroleum, Coal, Rubber and Plastics	154
Non-Metallic Mineral Products	198
Fabricated Metal, Machinery and Transport Equipment	75
Other Manufactured Products	262
Services (including Agriculture)	26

It is apparent that ECI values are different from one industrial sector to the other. Textiles, Wearing Apparel and Leather Production sector has the highest ECI value.

A Selected Industrial Sector – Food, Beverage and Tobacco

Table 9 shows investment and employment data of Food, Beverage and Tobacco sector.

Table 9: ECI values for Food, Beverage and Tobacco Sector

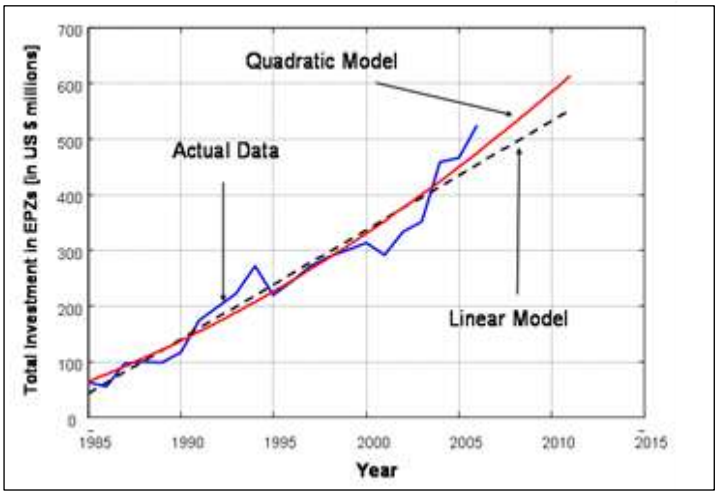
Year	Investment in US $(Million)	Direct employment opportunities	ECI
1995	38	8070	213
1996	80	6824	85
1997	134	8625	64
1998	176	11699	66
1999	167	11571	69
2000	147	15207	103
2001	126	15095	120
2002	154	14574	95
2003	163	13485	83
2004	210	14173	64
2005	270	14570	54
2006	309	13560	44
Mean	164	12287	88

Although it is not presented here, using the same procedure ECI values could be calculated for other eight industrial sectors too.

5.2 Forecasting Investment and Employment Generation for the Years 2008 to 2011

Figure 8 shows the future investment predictions for EPZs as a single entity with linear and quadratic models.

Figure 8: Forecasted Total Investment in all EPZs (in US $ million)



Fitted models are as follows for all EPZs.

Linear model (First order model):

$Y(t) = 21.8252t + 190.5973$ with $adj\ R^2 = 94$

Quadratic Model (Second order model):

$Y(t) = 1.9685t^2 - 1.7963t + 241.7772$ with $adj\ R^2 = 92$

In the linear model, accuracy of forecasting is 94% (adj R2) where as in the quadratic model it is 92%. Hence, linear model gives a better model as far as accuracy of the fitted curve is concerned. Table 10 shows forecasted investment and employment generation from 2008 to 2011 for all EPZs based on the linear model.

Table 10: Investment and Employment Generation for EPZs, 2008-2011

Year	Investment (US $ Million)	Employment generation
2008	457	163836
2009	476	169773
2010	494	175742
2011	513	181679

Using the same procedure investment is forecasted for the three EPZs- Katunayake, Biyagama and Koggala, separately. In all three situations first order (linear) model gave a better model as far as accuracy of the fitted curve is concerned than the second order (quadratic) model. Consequently,

employment generation of the three EPZs were forecasted. Table 11 shows forecasted employment generation for Katunayake, Biyagama, and Koggala EPZs.

Table 11: Employment Generation of Three EPZs, 2008-2011

Year	Katunayake	Biyagama	Koggala
2008	74147	40079	13814
2009	75966	41850	14515
2010	77784	43621	15215
2011	79603	45392	15916

6. Concluding Remarks, Limitations and Future Research

Governments of Sri Lanka rely on increased levels of investment to generate increasing number of employment opportunities in the country. In this study an indicator called ECI was defined to evaluate the employment generation based on investment. The employment generation was forecasted using both first order (Linear) and second order (Quadratic) models. However it is observed that in all situations first order model give a more accurate fitted curve than second order model.

The results show that country level analysis does not provide a clear picture of the situation analysed. The picture provided by industrial sector-wise is also blurred as industries vary in their contribution in employment generation. Similarly, the picture provided by all EPZs as a single entity is blurred as EPZs vary in their contribution in employment generation. Biyagama EPZ has the least contribution in employment generation although it has a considerably high amount of investment. On the other hand, Koggala EPZ has the highest contribution in employment generation although it hosts the least number of firms among the EPZ and it has the lowest amount of investment compared to the other two EPZs investigated. Therefore, the level of analysis has to be narrowed down to obtain a better picture of the investment and employment generation of the country. However, unavailability of information on employment at sector, ministry and industry levels is a main barrier in this regard.

Further, BOI records led to identify that the majority of firms establishing in the country bring more machine intensive production technologies than ever before or update existing production plants to accommodate advanced technology. The influence of this move is apparent from ECI values – the decreasing employment opportunities created per million US dollars invested. This raises the question "how effective is the strategy adopted to generate higher number of employment opportunities through higher level of investment?"

If sufficient data is available in the country, using the methodology proposed in this study, forecasting could be done to predict the manpower required for different skill categories. Such information could directly be used by educational and training institutes of the country to successfully link the growing pool of potential employees with a growing number of employment opportunities. This becomes especially important, if more technologically advanced factories are established in the industrial sector as BOI initiatives.

However, there are some limitations in this study. The unavailability of secondary data led to confine the main analysis to BOI initiated investments. No data was found by industries, sectors or Ministries. Therefore, there is a vital need for an employment database for the country, different industries, different sectors, and for Ministries. The methodology adopted in this study could be

applied to forecast employment creation based on past investment data of any other given sector or industry of a country. By the time this study was conducted, no models were available in the country to estimate future demand for labour. Future studies are needed to validate the models proposed in this study. When conducting the analysis we assumed that all other variables are constant. Hence, for instance, policy level changes that occurred with the changes of governments have not been taken into consideration in the study. One can argue that investment is a function of government led incentives and investment environment created in the country. Therefore, future studies can refine the methodology by incorporating environment changes into the equation.

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