Can Labour-Savings, Capital-Intensive Production Techniques Reduce Unemployment Rates in Developing Countries? Evidence from Malaysia

Ranald J Taylor
Murdoch Business School
Murdoch University

Abstract
Traditional economic wisdom predicts that unemployment rates will rise in many of the developing countries as a result of following an industrialisation process that utilised a labour-saving production technique. The findings of this paper suggest otherwise. Based on the development experience of Malaysia, unemployment rates were found to decline significantly when Malaysia switched from a labour intensive production technique to one that is capital intensive. The Malaysian experience suggests that initiatives put in place to encourage capital investment may lead to employment growth, thereby reducing unemployment.

1. Introduction
A pressing concern faced by policy-makers in many developing countries is how to expand productive employment at a rate sufficient to reduce prevailing levels of unemployment as a result of high population growth. The traditional solution to this problem is to follow a capital-saving and labour-intensive production technique. If there is a surplus of labour, it is more appropriate to adopt a low capital ($K$) to labour ($L$) ratio so that excess labour could be used in the production process. Utilising a higher $K/L$ ratio would mean that less labour could be employed, resulting in a further increase in unemployment rates. However, there are reasons to suggest that utilising a higher $K/L$ ratio will not automatically lead to higher unemployment rates, as predicted by the traditional view. Instead, greater employment opportunities can be generated with a higher $K/L$ ratio as a result of higher output growth brought about by technological progress embodied in new capital investments (Kaldor, 1960; Kaldor and Mirrlees, 1962; Salter, 1966). Accordingly, the higher the rate of capital investment, the greater will be technological progress, which in turn will lead to higher aggregate output growth, resulting in additional demand for labour.

The aim of this paper is to examine whether following a capital intensive, labour saving production technique can reduce unemployment in a developing country. Using Malaysia as a case study, it is hoped that further
light could be shed on the high unemployment rates found in many developing countries.

2. The Impact of Technological Progress on Output and Labour Utilisation

How can a capital-intensive and labour-saving production technique increase employment growth when less labour is required in the production process? One approach is through additional demand of labour generated by higher output growth rates driven by technological progress. According to Kaldor (1960), labour-saving production technique is technological progress. In his later writings, Kaldor (1967) argued that the key to development in the less developed economies is technological progress that is associated with ‘labour-savings innovations’ (p.56). The reason is that a higher \( K/L \) ratio is required in order to facilitate further improvement in labour productivity. Kaldor and Mirrlees (1962) pointed out that it is not possible to increase the productivity of labour by reducing the number of workers in relation to the existing capital equipment. Rather, productivity of labour is governed by the amount of capital equipment available for the worker to operate, that is ‘by the amount of investment per operative’ (Kaldor and Mirrlees, 1962, p.175). Furthermore, the acceleration of the retirement of old equipment is extremely important for accelerating technological progress. This is because ‘every change in the rate of investment per worker implies a change in the extent to which new ideas (innovations) are actually exploited’ (Kaldor and Mirrlees, 1962, p.189). In short, adding a layer of new capital equipment to the existing stock of equipment will accelerate technical progress, which in turn can induce higher labour productivity, resulting in increases in demand (in terms of higher quality and lower prices), and in the process, drive production and employment upwards.

Similarly, Salter (1962; 1966) argued that an expanding labour force, if not accompanied by an appropriate increase in new capital investment, would eventually lead to a dilution in the amount of capital per worker and through this, the risk of a lower rate of productivity would increase. Salter (1962; 1966) suggested that an increase in capital investment would result in a shift in the production function. New knowledge brought about by the embodied technology found in new equipment would ease the technical constraints, thus opening up a superior range of production possibilities. Based on this view, adding a layer of new capital equipment to the existing stock of capital will not only accelerate technical progress, but it will also generate additional employment needed for the operation of new machines. As such, capital intensive and labour saving production techniques are more likely to generate additional employment growth.

Technical progress brought about by capital accumulation is also found in Arrow’s (1962) ‘learning-by-doing’ analysis. In Arrow’s (1962) framework, any increase in physical capital investment will increase the stock of

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1 Earlier, Schumpeter (1942) pointed out that the rapid growth of the advanced capitalist countries was due to an ‘unexhausted stream of labour saving devices’ (pp.114-120).

2 In fact, Solow (2000, p.101) remarked that, ‘...there are more important sources of technological progress that have no relation to research and development. Arrow’s “learning by doing” is an example of just such a source or process’.
knowledge, which is crucial for sustainable long run output and employment growth. Here, knowledge is taken to be a function of total capital stock. New capital investment is not regarded as a carrier of technical progress, as in the vintage models, but instead represents its source. As workers learn how to harness the embodied technology found in new equipments, their productivity will increase, leading to lower production costs. This will spur additional demand, resulting in the utilisation of more capital equipment, which will increase employment. Arrow (1962) also associated replacement investment with technical progress. The rationale is that when a machine is being replaced, the latest model is likely to be technologically more advanced, and not simply a new copy of the old one. The higher the rate of investment, the greater will be the turnover of machines, and the greater will be technical progress and employment growth.

Discussion of the sensitivity of capital investment to output and employment growth can also be traced to earlier authors, such as Young (1928) and Myrdal (1957). They argued that output and employment growth are primarily driven by capital expansion, particularly in the manufacturing sector. In Young’s (1928) framework, technical progress is not just about economies of scale in production, but more importantly, it is a cumulative process associated with learning-by-doing activities during the production process. As workers master the operational process of the equipment, a higher degree of specialisation of human capital is possible. He cited Adam Smith’s principle of the division of labour, where workers acquired new skills during the production process. It is argued that these new skills lead to new forms of production techniques, spilling over into the production of new products or expanding the variety of products. This will result in the expansion of existing markets and the establishment of new markets, all contributing to new employment opportunities. Myrdal (1957) proposed that technical progress was driven by ‘the principle of circular and cumulative causation’. The mechanism driving the ‘cumulative causation’ is capital investment. The higher the rates of capital investment (channeled into the manufacturing sector), the higher will be the rate of cumulative causation, and this will lead to higher output growth, resulting in an increase in employment.

Recently, Greenan (2003) provided some empirics to support the proposition that the growth in employment is highly sensitive to technical change brought about by new capital investments. Based on a sample of 822 French manufacturing firms (with over 50 employees), for the period of 1988-1992, Greenan reported that the firms which invested in robots and computer-aided systems experienced employment growth of approximately six per cent higher than those that had not invested in similar technologies.

If technical progress is a major source of output growth, and if labour-saving production techniques are associated with technical progress, then an appropriate solution to reduce the high unemployment rates in most developing countries will be to follow labour-saving and capital-intensive production techniques. Adopting a capital-intensive industrialisation strategy will mean that there is an unbroken continuum in the evolution of
technical progress, as suggested by Kaldor (1960), Arrow (1962), Kaldor and Mirrless (1962), and Salter (1962; 1966). As Rowthorn (1999, p.423) asserted, ‘measures to stimulate investment could play an important role in helping to reduce unemployment, and that the present emphasis on labour market policies is exaggerated’.

3. The Malaysian Development Experience
Since the Federation of Malaysia was formed in 1963, the main objective of the Malaysian labour market policy has been to expand productive employment at a rate sufficient to reduce prevailing levels of unemployment as a result of high growth in labour participation rates, as depicted in Table 1.

Table 1  Malaysian Labour Market (’000), 1965-2000

<table>
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</thead>
<tbody>
<tr>
<td>Total labour force</td>
<td>3,246</td>
<td>3,874</td>
<td>4,522</td>
<td>5,109</td>
<td>5,916</td>
<td>7,042</td>
<td>8,140</td>
<td>9,743</td>
</tr>
<tr>
<td>Employed</td>
<td>3,048</td>
<td>3,607</td>
<td>4,225</td>
<td>4,817</td>
<td>5,468</td>
<td>6,686</td>
<td>7,915</td>
<td>9,438</td>
</tr>
<tr>
<td>Unemployed</td>
<td>198</td>
<td>267</td>
<td>297</td>
<td>292</td>
<td>448</td>
<td>356</td>
<td>225</td>
<td>305</td>
</tr>
<tr>
<td>Unemployment rate (%)</td>
<td>6.1</td>
<td>6.9</td>
<td>6.6</td>
<td>5.7</td>
<td>7.6</td>
<td>5.1</td>
<td>2.8</td>
<td>3.1</td>
</tr>
</tbody>
</table>


Rapid output growth was seen as the appropriate strategy in which to enable the labour market to absorb most of the increase in the labour force (Malaysia, 1971, 1976, 1981, 1986, 1991, 1996). Figure 1 indicates that the decline in output had a significant impact on the employment of labour on various occasions. During the 1970s, GDP growth averaged below 6 per cent and unemployment levels averaged above 7 per cent. When GDP rose by 8 per cent in 1980 from 3.6 per cent in 1975, unemployment decreased from 7 per cent in 1975 to 5.7 per cent in 1980. From 1990-2000, GDP growth averaged above 8 per cent and unemployment levels dropped below 4 per cent.

Figure 1  Real GDP Growth and Unemployment Rates, Malaysia, 1965-2000
The relationship between output growth and unemployment is not unique to Malaysia. Rather it has become an empirical regularity in the form of Okun’s Law. Okun (1962) found that a reduction in unemployment by one percentage point would require a 3.3 per cent growth in output. An important implication of Okun’s analysis is that the decline in output growth will not only lead to a reduction in employment opportunities, but also a decline in technological progress and productivity associated with unused labour.

An interesting feature of Figure 1 is that, from 1985 onwards, unemployment began to decline at a much steeper rate than that of the 1965-1985 period. A possible explanation of this trend can be linked to the changes taking place in the production structure of the Malaysian economy. Prior to the 1980s, labour-intensive production techniques were pursued, reflecting the characteristics of the Malaysian economy. As the agricultural sector accounted for a major proportion of both GDP and export incomes, it was targeted to become the main employer of the rapidly growing labour force. However, by the early 1970s, the agricultural sector was no longer able to absorb the growing labour force, leading to rising levels of unemployment. This put enormous pressure on the government to change its colonial patterns of production.

Emphasis on creating employment opportunities switched from a labour-intensive development strategy which centred around the primary sector, to a capital-intensive industrialisation strategy by expanding the manufacturing sector (Ali, 1992; Jomo, 1990; 1993; Jomo and Edwards, 1993; Rasiah and Shari, 2001). Soon after becoming the Prime Minister in 1981, Dr Mahathir implemented a series of initiatives to push the rapid industrialisation of Malaysia. To hasten the development of the manufacturing sector, foreign companies were given fiscal and monetary incentives to set up manufacturing plants in Malaysia (Malaysia, 1986; 1996). As a result, the capital intensive manufacturing sector expanded rapidly while the agricultural sector continued to decline significantly in terms of output to GDP and employment generation, as indicated in Tables 2 and 3.

<table>
<thead>
<tr>
<th>Table 2 Gross Domestic Product by Sector, Malaysia, 1955-2000 (in percentage)</th>
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</thead>
<tbody>
<tr>
<td>-----------------</td>
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<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Mining</td>
</tr>
<tr>
<td>Manufacturing</td>
</tr>
<tr>
<td>Service</td>
</tr>
</tbody>
</table>


3 Initially, the rubber and tin industries were able to absorb the increases in the labour force. With the decline in the prices of rubber and tin, these two industries found it increasingly difficult to maintain their traditional roles as the main sources of employment.

4 Under the direction of Prime Minister Mahathir, a series of Industrial Plans were implemented to spearhead the expansion of the manufacturing sector. The Heavy Industrial Corporation of Malaysia became the instrument in which to channel large capital investments into industries that were identified as suitable for national development.
The data in Table 2 show that the manufacturing sector experienced an increasing trend, rising modestly during the 1960s and accelerating subsequently. By 1990, the manufacturing sector surpassed the share of the agricultural sector in GDP growth.

Subsequently, the pattern of employment growth followed closely with Malaysia’s structural transformation. Table 3 shows that agriculture was the largest employer of labour in the 1960s, 1970s and early 1980s. However, as a result of the diversification policies during the mid 1980s, the proportion of total employment provided by agriculture began to decline, and in 1995, it fell to 20 per cent, and accounted for less than 20 per cent since.

Table 3  Employment by Industry, 1965-1998 (per cent)

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry, livestock &amp; fishing</td>
<td>52.1</td>
<td>53.4</td>
<td>47.1</td>
<td>40.2</td>
<td>30.1</td>
<td>26.2</td>
<td>20.1</td>
<td>17.3</td>
<td>18.8</td>
</tr>
<tr>
<td>Mining &amp; quarrying</td>
<td>2.5</td>
<td>2.6</td>
<td>2.2</td>
<td>1.7</td>
<td>0.8</td>
<td>0.6</td>
<td>0.4</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>8.4</td>
<td>8.7</td>
<td>11.1</td>
<td>15.8</td>
<td>15.2</td>
<td>19.9</td>
<td>23.3</td>
<td>23.4</td>
<td>22.2</td>
</tr>
<tr>
<td>Construction</td>
<td>3.5</td>
<td>2.7</td>
<td>4.2</td>
<td>5.2</td>
<td>7.4</td>
<td>6.2</td>
<td>8.1</td>
<td>9.3</td>
<td>8.7</td>
</tr>
<tr>
<td>Utilities</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.7</td>
<td>0.6</td>
<td>0.7</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Transport, storage &amp; Communication</td>
<td>3.9</td>
<td>4.1</td>
<td>4.4</td>
<td>3.8</td>
<td>4.3</td>
<td>4.5</td>
<td>4.7</td>
<td>4.9</td>
<td>4.9</td>
</tr>
<tr>
<td>Finance &amp; insurance</td>
<td>n.a.</td>
<td>0.8</td>
<td>0.9</td>
<td>1.7</td>
<td>3.9</td>
<td>3.9</td>
<td>4.8</td>
<td>5.2</td>
<td>5.1</td>
</tr>
<tr>
<td>Wholesale &amp; retail trade</td>
<td>11.1</td>
<td>11.4</td>
<td>12.2</td>
<td>12.7</td>
<td>17.6</td>
<td>18.1</td>
<td>17.8</td>
<td>18.4</td>
<td>18.7</td>
</tr>
<tr>
<td>Services</td>
<td>17.9</td>
<td>15.7</td>
<td>17.3</td>
<td>18.2</td>
<td>20.1</td>
<td>19.9</td>
<td>20.2</td>
<td>20.5</td>
<td>20.8</td>
</tr>
</tbody>
</table>


The sharp decline in unemployment from 1985 onwards seems to coincide with the rapid expansion of the capital intensive manufacturing sector. In order to determine whether Malaysia’s declining unemployment trend (shown in Figure 1) is linked to capital-intensive and labour-saving production techniques, the following sections will estimate the elasticity of employment with respect to output growth. The logic is that as the Malaysian economy matures, its employment elasticity should decline, reflecting the shift in production techniques. One of the reasons for the rate of growth in employment lagging behind the rate of growth in output lies with the nature of technical progress, which generally takes the form of an increase in the productivity of labour. This has the effect of economising the use of labour i.e. reducing the employment associated with a given increase in output. The pattern of output growth may tend to assume capital-intensive and labour saving forms.


To estimate the elasticity of employment over the years (t), a simple AR(2) model is used based on the following structure:

\[ \log Y_t = \alpha + \beta \log M_t + u_t \]

\[ ^5 \text{The AR (2) model is utilised to remove autocorrelation.} \]
where $Y$ is GDP at 1960 prices (1960=100), $M$ denotes total employment, and $u_t$ is the error term in that $u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \epsilon_t$. The estimate $\beta$ is the employment elasticity of output.

The period examined, 1959 to 1998, is divided into two sub-periods. The first period covers 1959-1980, while the second period covers 1981-1998. The purpose of this approach is to trace labour utilisation with respect to output growth between these two periods. Given the changing characteristics of the Malaysian economy between these periods, it is likely that the utilisation of labour would reflect this change. In broad terms, the Malaysian economy during 1959-1980 could be characterised as a labour-intensive production structure, dominated by the agricultural sector. During this period, on average, approximately 45 per cent of the total labour force was employed in the agricultural sector. From 1981 onwards, the capital intensive manufacturing sector grew at a faster rate than the agricultural sector, and by 1990, the manufacturing sector has supplanted the agricultural sector as the main contributor to GDP and employment growth.

5. Results and Discussion

The estimated employment elasticity with respect to output for the 1959-1980 period was 1.91 ($p < 0.05$), and 3.29 ($p < 0.05$) for the 1981-1998 period, as shown in Table 4.

### Table 4 Employment Elasticity of Output

<table>
<thead>
<tr>
<th>Dependent Variable is Real GDP: 1959-1980</th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>R-Bar$^2$</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-10.01</td>
<td>1.91*</td>
<td>0.98</td>
<td>1.89</td>
</tr>
<tr>
<td></td>
<td>[-1.84]</td>
<td>[0.12]</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent Variable is Real GDP: 1981-1998</th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>R-Bar$^2$</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-30.92</td>
<td>3.29*</td>
<td>0.96</td>
<td>1.94</td>
</tr>
<tr>
<td></td>
<td>[5.34]</td>
<td>[0.35]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All results have been treated for autocorrelation. Standard error in parenthesis. * significant at 5 per cent $p$-value.

The results show that during the period 1959-1980, a 1.9 per cent increase in GDP contributed to a rise in employment by 1 per cent, while for the 1981-1998 period, the Malaysian economy needed 3.3 per cent of GDP growth in order to attain 1 per cent growth in employment. This is expected because as the Malaysian economy shifted towards higher level of productivity, the usage of labour declined with a given level of output. The rising coefficient of employment elasticity in the second period suggests that a trend towards substituting capital for labour occurred from 1981 onwards.

The sectoral employment elasticity with respect to output growth for the period of 1947-1998 is shown in Table 5. Changing elasticities suggest a shift in labour utilisation. Between the periods 1947-1970, 1970-1985, and 1980-1998, the agricultural sector experienced a declining employment elasticity trend, from 4.4 per cent to 3.75 per cent, and to -1.18 per cent
respectively. This suggests that the productivity of the agricultural sector rose over time, with fewer workers needed to produce the same level of output. An implication of this rise in productivity within the agricultural sector is that more labour was made available to the non-agricultural sectors.

Table 5  Sectoral Employment Elasticity of Output, Malaysia, 1947-1998

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>4.40 (0.96)</td>
<td>3.75 (0.63)</td>
<td>-1.18 (0.88)</td>
</tr>
<tr>
<td>Mining</td>
<td>3.09 (0.88)</td>
<td>-1.58 (0.71)</td>
<td>-0.93 (0.99)</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2.46 (0.99)</td>
<td>1.26 (0.96)</td>
<td>0.50 (0.89)</td>
</tr>
<tr>
<td>Transport &amp; communications</td>
<td>n.a.</td>
<td>n.a.</td>
<td>1.04 (0.93)</td>
</tr>
<tr>
<td>Finance, insurance, real estate &amp; business services</td>
<td>n.a.</td>
<td>n.a.</td>
<td>-0.99 (0.97)</td>
</tr>
<tr>
<td>Construction</td>
<td>2.72 (0.99)</td>
<td>0.93 (0.98)</td>
<td>0.17* (0.46)</td>
</tr>
<tr>
<td>Government services</td>
<td>n.a.</td>
<td>n.a.</td>
<td>-0.64 (0.97)</td>
</tr>
<tr>
<td>Other services</td>
<td>0.93 (0.97)</td>
<td>1.62 (0.99)</td>
<td>-0.29* (0.82)</td>
</tr>
</tbody>
</table>

Notes: Figures in parentheses are correlation values.


c Based on the AR(2) model. All results have been treated for autocorrelation.

* not significant at 5 per cent p-value.

This switch to labour-saving methods of production largely accounted for the declining demand for agricultural workers. In 1965, the agricultural sector employed 52.1 per cent of the total labour force. By 1998, that figure had dropped to 18.8 per cent. In the 1965-1998 period, employment in the agricultural sector rose by approximately 765,000. This increase was, however, modest given the fact that the cultivated areas and tonnages more than doubled over the 33-year period. This clearly points to the adoption of labour-saving production techniques.

The declining coefficient of employment in the manufacturing sector provides a measure of an increase in productivity. In the Malaysian case, falling elasticity of employment in relation to output was most pronounced during the 1980-1998 period. The findings suggest that as the Malaysian economy matured, capital stock shifted or was transformed from a stock which was appropriate to labour-intensive production into one appropriate for less labour-intensive production.

Although the elasticity of employment with respect to output followed a declining trend (1959-1998), suggesting a rising capital-intensive trend, the underlying trend in unemployment rates was declining, as shown earlier.

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6 There is the possibility that the comparison of the current estimates with those of Rao (1980) and Huq (1994) may be inappropriate due to different time periods and methodologies (OLS). The intention of this paper is to provide an update, and some indication of the trend in labour usage between the different sectors of the economy.

7 Annual employment growth for the agricultural sector was 0.5 per cent in 1970-80 and -0.4 per cent in 1980-90, compared to 5.8 per cent and 4.7 per cent for the manufacturing sector over the same period.

8 During the 1966-1970 period, areas under cultivation totaled approximately 450,000 hectares (Malaysia, 1971). That figure rose to 1.8 million hectares in 1995 (Malaysia, 1996).

9 Tractor in use per hectare of arable and permanently cropped land rose from 1 unit in 1970 to around 5.7 units in 1998 (World Bank, 2000).
in Figure 1. Despite taking into account the recession of the mid 1980s (when unemployment peaked at 7.6 per cent in 1985), the unemployment rate averaged approximately 3.8 per cent during the 1981-2000 period. In fact, Malaysia experienced on average higher unemployment rates during the 1959-1980 period. In general, production during this period was labour-intensive and dominated by agricultural activities. Unemployment during this period averaged above 6 per cent compared to an average of 3.8 per cent in 1981-2000 (the capital-intensive period). Although less labour was needed to produce a given output (as indicated by the declining employment elasticity in the manufacturing sector and the economy as a whole), during 1988-1998, the Malaysian manufacturing sector on average generated more than 50 per cent of total employment. The rapid growth rate in the Malaysian manufacturing sector not only accelerated the transference of labour from the surplus agricultural sector to the productive manufacturing sector, but it also absorbed the increases in the labour force as a result of population growth. The Malaysian development experience suggests that following a capital-intensive and labour-saving industrialisation strategy will not automatically lead to increases in unemployment rates, as suggested by traditional analysis. In short, the Malaysian development pattern is a process that took the form put forward by Arrow, Kaldor and Mirrless, and Salter, where employment expansion is a process that requires intense capital investment.

6. Conclusion
The Malaysian development experience suggests that employment growth was not only largely linked to capital accumulation, but it was also sensitive to technological progress. An important lesson which may be drawn from the Malaysian experience is that a developing country that neglects the more capital-intensive manufacturing sector is more likely to experience a slower growth rate, and therefore lower employment growth. An important policy consideration is that initiatives put in place to acquire new capital, particularly to expand the manufacturing sector, will increase technological progress. Higher technological progress will increase output growth, which in turn will drive employment upwards.

References


