Externalities, Earnings and Surplus Labour in Jamaica: An Update

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Abstract

This paper justifies and specifies testable hypotheses about the relationship between the individual wage and the average level of subsistence productivity in the Jamaican labour market, as well as the degree of competitiveness. First, a framework is derived as a mathematical-economic model that links the marginal product of labour to the scale of unemployment or subsistence employment through the capital-output ratio and encompasses both Lewis surplus-labour hypothesis and the neoclassical alternative. Second, the implied specific testable hypotheses are formulated with a modified Becker-Chiswick-Mincer earnings function, which includes both log (hours worked) and log (weeks worked). Relationships are estimated using OLS with non-random selection of education and employment status on the one hand and a hierarchical random effects model on the other hand. Tests for competitiveness are conducted with Oaxaca-Blinder regression decompositions. Data are drawn from the Jamaica population census of 2001. It is found that there are conditions in the Jamaica labour market consistent with Lewis' surplus-labour assumption as well as uncompetitive labour markets and significant externalities. These conditions imply the need for development of a large scale domestic capital sector, real and financial, growing at a rate faster than the economy as a whole and for suitable industrial, trade and financial policy to achieve that goal.

Key words: surplus labour, externalities, elasticity, earnings function, hierarchical model

Introduction

This paper uses a modified Becker-Chiswick-Mincer earnings function and data from the Jamaica population census of 2001 to assess the relationship of individual earnings and the average level of subsistence earnings in Jamaica, where up to 40% of the labour force still operates outside the capitalist sector. The purpose is to determine if the Lewis surplus-labour assumption still applies. The specification exhibits the elasticity of earnings to the supply of labour of paid employees and the self-employed, the latter being the main focus of Lewis' surplus-labour assumption (1954). The paper first summarises the Lewis conditions for the existence of surplus labour and the neoclassical reactions in Section I. Section II sets out a theory of the earnings-subsistence productivity-labour supply relation, assuming that working individuals seek to maximise net household consumption after confronting the challenges of making necessary investment to be

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employable. This framework links individual earnings to several group aggregates, in particular parish aggregate productivity, parish subsistence productivity and parish education stock. The existence of uncompetitive conditions is treated as an empirical matter. The resulting statistical earnings-labour supply functions are specified and estimated in Section III. The reported results support the hypotheses that, on average, the earnings of a self employed person depends mainly on subsistence sector productivity, just as Lewis had observed, and the general distribution of employed persons (paid and unpaid) is uncompetitive.

Surplus-labour in Lewis and neoclassical objections

In his work on development economics, Lewis tackled three main problems: (1) the relative price of agricultural and industrial products; and (2) the associated patterns of distribution - the adjustment of the real wage rate as capital accumulates; and (3) the fundamental forces determining the comparative rates of growth of agricultural and industrial countries or sectors. His common solution of these problems was to use the classical assumption of an unlimited supply of labour available to a capitalist sector from an indigenous non-capitalist sector at subsistence wages. For Lewis, it was necessary that the work of the subsistence worker is not significantly fructified by reproducible capital (Lewis, 1954; 1979/1992). We use schooling to epitomise reproducible capital in Jamaica. In the context of the modern earnings-employment function, it is sufficient that there exists a substantial class of workers outside the wage-labour market, whose earnings are determined mainly by the collective average productivity with a significant role for background family assets but with none for individual years of schooling. So the subsistence workers would be socially unskilled (Lewis, 1954:144-5). One also expects a highly inelastic response of individual earnings to changes in the supply of labour in the subsistence sector. This heterogeneity implies that, given existing capital and technology and subsistence supply conditions as specified above, the subsistence wage sets a floor to the capitalist wage and capitalist market demand at the average subsistence earnings cannot absorb the available subsistence supply of labour. Lewis' extreme assumption of perfect earnings inelasticity was a matter of convenience – a manner of postulating that even if capitalist employment of labour is dictated by the marginal product of labour, that marginal product could not drive the capitalist wage to zero because the subsistence productivity ensures that new labour is not available to the capitalist sector at zero wage (Lewis, 1954; 1955; 1958; Ranis, 1997: 2, 3).

From the start, some economists objected to Lewis' formulation as assuming uncompetitive conditions in the face of indications to the contrary (Viner, 1957; Cumper, 1963; Schultz, 1964; Kao, Anschel and Eicher, 1964; Hansen, 1969; Harris and Todaro, 1970). The general argument was that if a marginal unit of labour with known technologies leads to additional output, then it would be worth spending the associated positive wage to extract it (Viner, 1957). On the other hand, withdrawal of a marginal unit from subsistence employment would leave output unchanged, especially if the withdrawal of the marginal unit is tied to simultaneous withdrawal of a large number of workers. So, as a group, such marginal units should in principle bid the capitalist wage

below the subsistence average if necessary. It could not be sustained above zero (or the marginal product) except through non-economic forces such as unions, convention, social prestige and so forth (Schultz, 1964; Cumper, 1963). Empirical supply functions for the landless and the landholding classes for countries such as India and Taiwan have been derived on the assumption of competitive conditions and neoclassical data on consumers and producers. They show standard highly inelastic, even backward-bending, supply curves for the landless. Claims of uncompetitive labour markets with the subsistence wage above equilibrium and infinitely elastic supply response are thereby deemed flawed (Rosenzweig, 1980, 1988; Adulavidhya, Kurida, Lau, Lerttamrab, and Yotopoulos, 1979).

Some scholars have rejected the logic of the mainstream objections, especially to its failure to recognize that subsistence productivity tends to rise with the withdrawal of labour from the sector, partly because of ongoing technical change (Sen, 1967; Hymer and Resnick, 1967; Ranis, 1997). While these are important rejoinders, what is relevant is that Lewis' claims cannot be evaluated in the standard neoclassical framework, such as was set out in Rosenzweig (1980), since it does not allow the average subsistence productivity to be a rationally binding infimum of the capitalist wage, as proposed by Lewis (1954:147). A more encompassing framework is needed in which to derive, compare and test the contending hypotheses. Interestingly, Lewis' model provides the basis for that.

An Encompassing Framework

Central to all economic analysis is the relationship between the marginal product of labour and employment, taking into account the size of the current labour force. Let $L(\delta(t))$ be the labour force, $b(t)$ maximum marginal product of labour in the capitalist sector, $n_*(t)$ capitalist sector employment if subsistence labour exists, $n_f(t)$ capitalist sector full employment in the absence of subsistence labour, $\delta(t)$ the labour force participation rate, $\varphi_{sub}(t)$ subsistence sector labour productivity, $K(t,q(.),M(t))$ the total domestic capital stock, *M(t))* the total imported capital stock, *k(t)* the capital stock employed at some utilisation rate, *m(t)* the quantity of imported capital employed at some utilisation rate, and $q(n(t), k(t), m(t), \varphi_{sub}(t))$ system-wide total as distinct from potential output – potential in that *n(t)* is efficiency adjusted and a full specification takes account of the achievable speed of work and would be written *n(*$\phi(t)$*)*. In general, the differential equation of the marginal productivity of labour implied in the geometry of Lewis (1954) can be represented as the quadric

$$1. \quad \frac{(\frac{\partial q}{\partial n})^2}{b(t)^2} + \frac{n(t)^2}{L(\delta(t))^2} = \frac{K(t,q(.),M(t))^{\alpha}}{q(n(t),k(t),m(t),\varphi_{sub}(t))]^{\beta}}$$

for $q(n(t),k(t),m(t),\varphi_{sub}(t) > 0, \quad b(t) > 0$ and $L(\delta(t)) > n(t) > 0$ and with different relative values of the RHS tracing out level curves of the relation. Observe that the left

hand side sums the ratio of the actual to maximum possible capitalist sector employment and the ratio of the actual to the maximum marginal product of labour in the capitalist sector. The right hand side of (1) is a generalised form of the capital-output ratio.

It is also interesting that b is also readily shown to be related to the sum of structural unemployment and underemployment, i.e.,

2. $b = \sqrt{L(\delta)^2 - n_{eq}^2}, n \geq 0, q \geq 0$.

where n_{eq} is the equilibrium employment rate under appropriate assumptions and thus can take values such as $n_*(t)$ or $n_f(t)$. So clearly, all economies can be compared using the characteristic development parameter

3. $$\Lambda = (1-(\frac{b^2}{L(\delta)^2}))^{\frac{1}{2}} = \frac{n_{eq}}{L(\delta)}$$

which is to say, the rate of capitalist employment of the labour force. This rate depends on the ratio of the maximum marginal product of labour to the labour force $\frac{b}{L(\delta)}$, which by (1) depends on the domestic capital-output ratio. It can be so low at particular levels of the capital stock and capital-output ratio that a large share of the labour force is in subsistence employment and could generate Lewis' effects. Similarly, it can be so high that only frictional employment exists. It is an empirical matter. Lewis' (1954:149) geometry indicates that the lower the scale and level of development of the capital stock and (the local and global) technology of the economy, the sparser and more distinct the technical options available, the lower the initial level of output, capital-labour ratio and maximum marginal productivity of labour, the higher the initial ratio of $\frac{b}{L(\delta)}$ and the faster does the marginal product fall off as techniques change and the smaller will be Λ. With a more developed domestic capital sector and hence wider access to local and global technology, the lower the initial value of $\frac{b}{L(\delta)}$, the denser the space of techniques and the more slowly does the marginal product fall off as alternative techniques are considered. Correspondingly, the larger is Λ. Higher Λ is an indicator of a relatively highly developed capital stock and economy. Smaller Λ is an indicator of a relatively poorly developed capital stock and economy.

Thus, equation (1) is sufficiently general to encompass both classical and neoclassical propositions about how demand and supply shape wage formation and employment. As capital production and capital-labour substitution proceeds, the marginal product of labour, $\frac{\partial q}{\partial n}$, may fall, but there is a limiting long run position $P(n_{eq}, \frac{\partial q}{\partial n}(n_{eq}))$ at the maximum capitalist employment affordable with the existing capital stock, subject to relevant constraints. That is, there is $n=n_{eq}$ such that $\frac{\partial w}{\partial n} = 0$ though $\frac{\partial q}{\partial n} > 0$ and

$L - n_{eq} > 0$. At such a point, we must have $\frac{\partial k}{\partial n} = 0,$ so that in the capitalist sector, technical switching and factor substitution stops in the direction of *n, though it may proceed in other directions.* Capitalist surplus or profit is assessed when all labour is paid the same general wage at the point $(n_{eq}, [\frac{\partial q}{\partial n}](n_*))$. Switching is induced by the prospect of persistent profit when a new technique is introduced and both $\frac{\partial q}{\partial n}$ and employment change in an ordered process starting at *b*.

Regarding the supply of labour, Lewis' (1954, 1992) most important proposition is that when capital is absolutely scarce and surplus labour exists, there is no practical need for firms to offer, collectively or individually, a schedule of rising wages in order to variously attract labour from current use or to move from less to more labour-intensive techniques: surplus-labour keeps wages down and relatively constant with a floor defined at the average product of subsistence labour. Individuals are interested in income in order to attain certain lifestyles that not only allow them to keep up with the Joneses (Lewis, 1954:152) but also to win opportunity to convert endowments into income. In Jamaica, the Joneses embody a preferred sociology of race, speech, dress-code, colour and other inherited discriminatory devices along with respect, freedom and independence that force prior household investment as conditions for access to capitalist sector jobs. If the average product of the self-employed offers a more realistic prospect of attaining the desired lifestyle, it is chosen – hence its role as a floor. Thus, for Lewis (1954), under surplus labour conditions, the wage responds inelastically to employment and the supply function is characteristically a line segment passing through the point $P(n_{eq}, \frac{\partial q}{\partial n}(n_{eq}))$, with $n_{eq} = n_*(t)$ with $n_*(t)$ and b reflecting the presence of subsistence labour. The point $(n_*, [\frac{\partial q}{\partial n}](n_*))$ is characterised by $[\frac{\partial q}{\partial n}](n_*) = \varphi_{sub} = w_{n_*}(t)$, with $w_{n*}(t))$ obtained from (1) as

$$4. \quad w_{n*}(t) = \sqrt{\{\frac{[K(t, M(t))]}{[q(n(t), k(t), m(t), \varphi_{sub}(t))]} - \frac{n_*(t)^2}{L(\delta(t))^2}\} b(t)^2} \ .$$

The situation only changes when there is a sufficient accumulation of capital to make subsistence work irrelevant, create shortages and eliminate the wage-suppression effect. Equilibrium employment is governed by demand. The effect of capital accumulation and growing output is to trace out a boundary surface for (3) associated with different level curves of (1), with different levels of employment at the maximum consistent with either a changing or constant capitalist wage. Specific versions of these are exhibited in Lewis' geometry but the boundary may be parabolic, linear, and even hyperbolic, depending on the assumptions made about the behaviour of $K(t, M(t))$ and $q(n, k(t), m(t), \varphi_{sub}(t))$ as well as φ_{sub}. This general relation is also consistent with the propositions of Cumper (1963) or Ranis (1997, 2004), featuring a varying wage if the average productivity of the self-employed changes as domestic capital accumulates.

Lewis (1954:149) further proposed that the average productivity of subsistence labour is time-invariant for a significant period and so is the average wage at which employment expands. Thus, we have some period $t_0 < t < t_n$ such that

$$5. \quad \frac{\partial q}{\partial n}|_{n_*}(t) = \varphi_{sub} = w_{n_{*0}}$$

fixed over time. The effect is that capital accumulation traces out a time-indexed boundary **line segment** of varying employment but with no change in the capitalist wage (i.e., of infinite wage inelasticity). To derive the conditions for a Lewis wage-employment relation such that the capitalist employment rate grows (Lewis, 1954:149), consider any other period $t > 0$ and equate the wage rates to get

$$6. \quad (\frac{n_{*t}}{L(\delta_t)})^2 b_t^2 - (\frac{n_{*0}}{L(\delta_0)})^2 b_0{}^2 = \frac{b_t^2 K(t, M(t))}{q_t(n(t), k(t), m(t), \varphi_{sub}(t))} - \frac{b_0^2 c_0}{q(n(0), k(0), m(0), \varphi_{sub}(0))}$$

Intuitively, (6) implies that for the employment rate to rise, after taking into account the rising labour force participation rate and the rising maximum productivity of the capitalist worker, the domestic capital stock must grow relative to the output rate. That is, the domestic capital stock must rise faster than output to raise the employment levels while the labour-force participation rate nevertheless grows to sustain the downward pressures on the wage. For such an outcome, there must be a *new (domestic) capital component of output* which grows faster than total output and increases output and employment relative to the size of *L* such that the employment rate drifts towards full employment.

Such new domestic capital must be produced by employing available subsistence workers (Lewis, 1954: 144, 152-55). Thus, the marginal product that determines new employment is that of the worker brought from the subsistence sector to produce the new capital without using any available capital. In general, rather than simply being preoccupied with optimal allocation, firms must draw on subsistence workers to compete by creating a wider range of techniques for advancement and growth. This requires knowledge-creating strategies that aim to expand technical options and business opportunity in the future by introducing creative approaches to knowledge creation and strategy development, bargaining power relative to suppliers, workers, and customers as well as government and other stakeholders, local and foreign. Successful overall knowledge creation for this purpose relies heavily on creation, communication, sharing and use of tacit knowledge in production and marketing (Lewis, 1955: Chapter IV). The marginal product of such labour cannot drive the capitalist wage below the average subsistence productivity because either the new capital would not be produced if the workers are not sufficiently productive or it would be produced at a wage higher than the current average productivity of the self-employed, creating a "cliff" to attract worker from subsistence activity (Lewis, 1954:148; 1955: 164; Ranis, 1997:3). It would not be rational for persons with the option of a lifestyle made possible by that average income to create capital for a worse lifestyle provided by a lower capitalist wage.

For the neoclassical case, the assumption of competitive conditions implies that under the existing sociology there is no level of capital that cannot employ all workers in a capitalist mode and only the full employment of the labour force can halt the substitution process. In particular, in the search for optimal profits, continuous substitution proceeds such that $w = \frac{\partial q}{\partial n} \to 0$ so that there exists no surplus labour, $n_* \to n_f \to L$ and decline of $\frac{\partial q}{\partial n}$ is halted only by required frictional unemployment. Substitution drives $\frac{\partial q}{\partial n}(t)$ to its lower bound such that, at any *t*,

7. $$\frac{\partial q}{\partial n_{|_{nf}}}(t) = w_{n_f}(t) .$$

At the same time, in the face of labour supply shortages, firms can effectively induce workers from existing employment by offering a schedule of higher wages. This defines the standard neoclassical supply curve *for a given set of techniques*. However, the effect of capital accumulation and output growth under competitive conditions is to trace out a time-indexed neoclassical wage-full employment curve with $n_f(t)$ and hence $b(t)$ implying only frictional unemployment, no subsistence worker, no externalities, and hence no role for the average product of the subsistence worker in shaping the wage. Write

8. $$w_{nf}(t) = \sqrt{\{\frac{[K(t, M(t))]}{[q(n(t), k(t), m(t))]} - \frac{n_f(t)^2}{L(\delta(t))^2}\} b(t)^2} .$$

Conditions similar to (4) and (8) can be defined for other values of α and β. For example if $\alpha = \beta = 2$, then as $q(n(t), k(t), m(t), \varphi_{sub}(t))$ varies under the influence of a changing $K(t, M(t))$, equation (1) permits sets with positively sloped linear rather than parabolic boundaries.

At the micro-level, the Lewis surplus-labour hypothesis implies that the average productivity of the subsistence worker is a particular social outcome that influences individual earnings. No such social outcome operates in the neoclassical case, so this serves well as contrast. Rejection of the surplus-labour hypothesis follows from demonstration that the average productivity of the self-employed is not a significant determinant of the wages in the capitalist sector and that the earnings of the self-employed are systematically influenced only by the average earnings of subsistence workers and not significantly by the value of any type of capital, such as education. Also, competitive conditions prevail if rates of return on education and other forms of capital are equalised between the sector of the self-employed and the capitalist sector. The next section formulates a unified extended Becker-Chiswick-Mincer model with which to test these contrasting hypotheses while addressing underlying assumptions about competitiveness and externalities.

Specifying the Earnings - Labour Supply Relation

Let T_h be hours worked per week, T_w weeks worked per year, y_s average parish productivity of the subsistence economy, h a measure of the education component of the human capital of the individual and F a vector of experience, on the job training, household characteristics and other aspects of the human capital of the individual that shape the wage. Further, let H be an indicator of the average level of education in a parish and μ be the proportion of H devoted to production uses other than production of more human capital.

If one assumes an appropriate parish productivity function that is independent of current earnings, one can use Chiswick (1997) and Acemoglu and Angrist (2000) and James (2006) to show that the relationship of real annual earnings (w) and the labour-supply of an individual can be expressed as the following multiplicative model:

9. $$w = Be^{\gamma_f F} h^{\alpha} T_h^{\gamma_h} T_w^{\gamma_w} y_s^{\beta_1} (\mu H)^{\beta_2}$$

with the coefficients α, γ_h and γ_w as elasticities. The sum of the employment elasticities, $\gamma_h+\gamma_w$, describes the gross adjustment of earnings to employment (hours and weeks).

Further, we can follow Acemoglu and Angrist (2000) and specify h as

10. $$h = \exp(s\Upsilon)$$

where Υ is an indicator of unobserved individual ability, knowledge and skill, some acquired through experience in the subsistence economy. Assuming that $\mu=1$ and taking logs on both sides of (9) gives

11. $$\ln w = \ln B + \alpha s\Upsilon + \gamma_f F + \beta_1 y_s + \beta_2 \ln H + \gamma_h \ln T_h + \gamma_w \ln T_w$$

If it is assumed that all workers choose their time of work, equation (11) is an appropriate basis for estimating how the supply of labour and human capital is related to earnings in various segments of the labour market.

Interpreting the Employment Coefficients

Chiswick (1997:10) suggests that under conditions of a tight labour market, one expects $\gamma_w=1$ and $\gamma_h<1$. If γ_h and γ_w are close to zero and if also β_1 is not zero in either the capitalist or the subsistence sector but $\alpha = 0$ in the subsistence sector, then the results would favour the hypothesis of a surplus labour market. That is, change in the expected individual earnings from the subsistence average is expected to be very small in response to a change in employment. Here, it is useful to observe that labour supply decisions are likely to be endogenous with respect to earnings, whatever the employment status. No

suitable instruments are available to address this problem. However, Chiswick (1997) points out that the likely effect of this is upward bias in the estimates of γ_h and γ_w. On the other hand, measurement error in the earnings data could generate a downward bias. The effects may offset each other.

Testing for Competitive Conditions

Tests can be devised for competitive conditions using (11). Competitive markets would eliminate externalities, driving the social rate of return to the private rate. Some external returns to education are reflected in $\beta_1 + \beta_2$ and the most interesting null is that $\beta_1 + \beta_2 = 0$. However, the separate hypotheses are also interesting. Here, $\beta_1 > 0$ should indicate existence of pecuniary externalities and in particular that y_s serves as binding capitalist wage floor, in that those operating in the subsistence economy will only accept work in the wage labour market if lured by a sufficient increase over y_s. These conditions bind for expanding capital. If $\beta_2 > 0$, there are non-pecuniary spillovers from H into individual incomes, depending partly on whether firms can find a ready supply of employable skills available in each parish and partly on the extent to which non-pecuniary forces are at work to encourage better worker sharing of knowledge and innovation that boost profitability (Acemoglu and Angrist, 2000). These externalities are additional to Chiswick's (1997:7) social returns that can be calculated using α and data on the portion of the working year worked by the individual[i] and the cost of schooling borne by the public defined as a percentage of the full-year foregone (potential) earnings.

Second, competitive conditions imply that the earnings of all employees should be driven to match their productivity by competitive conditions, certainly over any span as long as 5 decades (Ranis, 1997). The measurement of market uncompetitiveness by using comparisons of rates of return to the human capital of the self-employed and the paid employees (or other market segments) is now well established (Grubb, 1993; Tucker, 1985; Heywood and Wei, 2004), especially with the regression decomposition methods pioneered by Oaxaca (1973), Blinder (1973), and recently extended by Jann (2005). For any appropriate model specification, these techniques decompose the differences of earnings into differences due to: (i) the explanatory factors (variables and instruments); (ii) the coefficients, which would mirror the breakdown of the assumption of competitive conditions; and (iii) the interaction of variable differences and coefficient differences. Assuming that the data on the self-employed are productivity indicators, divergences in the rate of return and other evaluation coefficients between employment groups that favour the paid employee would also be an indicator of the tendency for earnings to diverge from their productivity in the capitalist sector.

Testing for surplus labour conditions

The estimates presented here use data from the Jamaica Population Census of 2001 and its wide range of controls to provide some insight into the persistence of barriers between the capitalist segment and the segment of the self-employed in the labour market of

Jamaica. Through variable *F,* the model in (11) takes advantage of a wide range of controls available in the census, such as family wealth and social background, social networking capital, and industry of employment. Personal factors include age and potential work experience; union status indicated by whether a person is in any type of marriage or live-in arrangements; race; sex; and health status. The indicators of family wealth and social background include: (i) the types of stove one uses (electric versus other); (ii) household size; (iii) the type of sanitary facilities; (iv) the type of materials from which the home is built; (v) the type of water access; and (vi) the economic efficacy of social networking as indicated by "religious affiliation". Industries are measured at the 1-digit level as defined in the Jamaica Standard Industrial Classifications.

Jamaica census data for 1991 and 2001 show that the share of workers outside the capitalist sector grew from 37% to 41% between 1991 and 2001, suggesting that the capital accumulation process does not systematically reduce the size of the subsistence sector. So, there is reasonable context for probing the surplus labour hypothesis.

Years of Schooling and Instrumentation

A central concern with use of years of schooling as a regressor is its correlation with the error term, which causes breakdown of the zero-condition-mean assumption. One aspect of this is genuine simultaneity in the determination of earnings and employment of skill, since a person must necessarily choose a level of education that can yield anticipated access to employment and wages if a paid employee or anticipated productivity and net return on the skill asset if self-employed. The anticipated payback motivates the decision just as the education outturn influences the pay scale achieved (Acemoglu and Angrist, 2000). Another aspect of the breakdown is the tendency to lump inadequately measured personal characteristics into the residual term. The main unmeasured personal characteristic is usually thought to be ability, which leads to both high income and high educational attainment. The common solution to both challenges is use as an instrument the quarter of birth measure of acquired and natural ability recommended by Angrist and Krueger (1991). The rationale for the quarter of birth measure is the expected effect of laws in Jamaica requiring mandatory primary school attendance by a given age (6 years) starting in September but with flexible exit of any school starting at about 13+. Children born during a 1-year period would all begin school together in September but some may drop out as soon as the law permits at 13+, so that a child's month or quarter of birth may force one child to attend school for up to a year longer than another resulting in differences in acquired and accumulated natural learning ability for any given age.

Data for this instrument are available in the census but its use has been questioned by many authors such as Bound, Jaeger and Baker (1995) and Imbens and Rosenbaum (2005). In that regard, if ability is also altered by formal schooling, one can extend Angrist and Krueger (1991) and Acemoglu and Angrist (2000:7) by modelling Υ to reflect how ability is altered by schooling and experience in the subsistence economy. Write:

12. $\Upsilon = \Upsilon(s, y_s)$

However, it can be shown that use of (12) adds little information to the specification. In particular, assume a household faced with the challenge of employability in the capitalist sector. The cost of living is more than ordinary consumption – it involves necessary subsistence and a set of investments aimed at guaranteeing access to income opportunity (Nell, 1998: 288-358): *s,* the education and skills obtained through schooling; and *k*, the mixed assets comprising real and social capacity, land and information created for flexible movement into new forms of employment and socialising for marketing of ability or output. We adapt Nell (1980) and Acemoglu and Angrist (2000) in postulating that the worker maximizes a constrained consumption function of the form

$$13.\quad \max C = \ln w - \frac{\theta}{2}k^2 - \frac{\pi}{2}s^2 - \frac{\varphi}{2}y_s{}^2 \\ -\lambda[\ln w - \ln B - \alpha s\Upsilon(s, y_s) - \gamma_f F - \gamma_h \ln T_h - \gamma_w \ln T_w - \beta_1 \ln y_s - \beta_2(\ln\mu + \ln H)]$$

where θ is the cost of the mixed assets, π is the cost of schooling and φ is the cost of investing in acquiring the subsistence bundle through subsistence activity. The first-order condition for optimal choice of schooling can be shown to yield

$$14.\quad \frac{\Upsilon_s(s, y_{sub})}{\Upsilon(s, y_{sub})} = \frac{\eta}{s}$$

or

$$15.\quad \ln(\Upsilon(s, y_{sub})) = \eta \ln|s| + C$$

Equation (15) suggests that ability and schooling may be relatively simple translations of each other, once ability can be altered by the schooling process. In a regression model, the instrumentation of schooling with variables that tie ability to schooling would likely add little to the information available. The average level of ability in a parish also cannot be readily observed but the above results also imply that significant bias should not result from use of the expected (average) level of schooling in the parish (Acemoglu and Angrist, 2000).

Possible surplus labour supply function – Model 1

In the light of the concerns of Bound, et al. (1995) that instrumentation of years of schooling with quarter of birth does not add much information, we adopt a two-stage stage estimation process following Lee (1983) and Tansel (2000). This approach is consistent with Lewis' (1954) argument that a microeconomic earnings function should account for employment sector selection. In the first stage, an ordered probit model is specified to predict the probability of passing the formal exam screens that allow entry into high years of schooling or into various jobs. The exam screens are defined and coded as in **Table 1**. The ability to pass exams is modelled as a function of personal, household and community characteristics. The individual characteristics are: (i) innate ability as

indicated by quarter of birth, (ii) age, (iii) marital status indicated by whether is person is divorced or not and (iv) networking as indicated by whether religious affiliation, (v) race, (vi) whether one is male or female and (vii) one's health status. Success at examinations involves a substantial amount of family support, tied to the family wealth status, as specified above. The nature of the household experience with crime-related stress also matters, with particular regard to whether anyone on the household has ever been a victim of robbery. Finally, it is also postulated that learning outcomes are affected by the general economic conditions in the parish of residence, in particular by: (a) the average stock of education in the parish of residence, (b) the age structure of the parish of residence as indicated by the percentage of persons of working age (between 14 and 55); and (c) the average level of earnings in the parish of residence.

Estimates reported in **Table 2** indicate that persons with greater ability or who view themselves as being of mixed or white race are all more likely to have passed high-level exams. The same applies to persons who live in parishes with a large stock of educated persons, a high average level of earnings as well as persons who belong to strong social networks and come from wealthy households. Males, persons who are from poor households, large households or households with many children or from household who have been exposed to the trauma of crime as well as persons from parishes with a high concentration of elderly persons are all likely to pass no exams at all or pass only at low levels. The "linktest" indicates that the estimated model is reasonably well specified with respect of the nonlinear terms needed in the functional form, since the coefficient on the square of the forecasted values of the regressors is not statistically different to zero at any conventional level of significance.

Table 1: Description of Examination Screens in the Jamaica Education System as Applicable to the Census 2001

Results	Description	Code
No passes	No passes	**0**
CXC basic or equivalent	Unsatisfactory performance of Grade 11 examinations; recognised as having attempted the examinations	**1**
1-3 CXC O-levels or equivalent	Satisfactory passes up to 3 subjects.	**2**
CXC 4+	Satisfactory passes for at least 4 subjects.	**3**
GCE A Levels	This is the special entry level for the 3-year degree at the University of the West Indies or universities in Britain.	**4**
College Certificate/Diploma	Teachers' certificates, diplomas offered after basic nursing training, police academy training and other lower-level professional training institutions.	**5**
Associate Degree or Other	Equivalent to the typical two-year college degree.	**6**
Degrees and professional qualifications	Complete undergraduate or post-graduate qualifications & special professional qualifications.	**7**

Table 2: Ordered probit model of highest examinations passed, with results of "linktest" for model specification			
Number of Obs=40711			
LR chi2(23)=11831.6	Prob >ch12=0.0000		
Log likelihood =-39447.3	Psuedo R2=0.1304		
Dependent variable is "**Ordered indicator of highest exam passed**"	Coef.		P>|z|
Ability as measured by quarter of birth	0.0237		0.000
Mean years of schooling in parish of residence	0.2742		0.000
Age structure – the percentage of persons of working age 16-65 in parish	-1.6945		0.026
Log of the average annual earnings of the parish of residence	0.1266		0.028
Age	0.0897		0.000
Age-square	-0.0027		0.000
Age-cubed	0.0000		0.000
Divorced	0.5431		0.000
Anglican religion	0.6445		0.000
Catholic religion	0.6589		0.000
Electricity as fuel for lighting or cooking	0.3285		0.000
No of children in home	-0.0456		0.000
Household size squared	-0.0043		0.000
Pit latrine	-0.4214		0.000
Wood (walls of house)	-0.3525		0.000
Wood and concrete (walls of house)	-0.3154		0.000
No toilet in house	-0.5352		0.000
Public pipe indoors with running water	0.5199		0.000
Mixed race	0.3949		0.000
White race	1.9092		0.000
Male	-0.3465		0.000
Experienced robbery of household	-0.0737		0.001
Hypertension	-0.1049		0.008
Linktest Results			
predicted dependent variable	0.9069		0.000
Square of dependent variable	0.0113		0.277

These results find significance in relation to the role of the ability to pass exams in determining whether a person would have to choose self-employment over paid employment in the capitalist sector. In this regard, a (binary) probit model was also estimated to account for non-random choice of employment status as either a paid employee in the capitalist sector (coded **1**) or as a self-employed person without employees (coded **0**). Like Lewis, studies such as Le (1999), Finnie, Laporte and Rivard (2002:2) and Tansel (2000) argue that self-employment is explained partly by the inability to find suitable conventional employment (unavailability of work), generally linked to the unemployment rate. We use the unemployment rate of the parish of residence. Other personal preference factors are indexed to age, the level of labour market experience, household resources, managerial skill (type of degree and learning abilities) as measured by the highest examination passed. In this respect, partly as an identification device, the inverse Mills ratios (IMRs) of the ordered probit model are used as regressors in a model of employment status to reflect the effects of formally acquired

learning ability on employment status. Further, employment status is associated with other household characteristics, such as marital status and the presence of children in the home.

Estimates reported in **Table 3** indicate that persons with high years of schooling, persons working in the jobs for which they are trained or with high earnings are more likely to be paid employees of the capitalist sector. Persons from parishes with a high share of service sector employees are also more likely to be in capitalist sector. On the other hand, persons who are older, heads of households or in formal or informal live-in arrangements are also more likely to be self-employed. The same applies to persons with low acquired academic ability and persons with very high acquired academic ability as manifested in a degree or professional training.

Self-employment seems to be explained partly by the inability to find suitable conventional employment, as persons from parishes with a high unemployment rate are more likely to be self-employed. Importantly too, high productivity among the self-employed appears to encourage entrepreneurship. Persons from parishes with a high average productivity among the self-employed are also more likely to be self-employed. The reported specification tests indicate reasonable specification of the nonlinearity in the functional form. However, an important caution from the estimation process is that it might make a significant difference to the results if data were available on the missing cases.[2]

[2] The main lesson here is the need for substantially greater care in collecting data on earnings.

Table 3: Probit model of employment status with specification test results			
Number of obs=42419			
LR chi 2(32) = 17644.74	Prob >chi2 =0.0000		
Log likelihood=-20137.4	Pseudo R2= 0.3046		
Employment Status	**Coef.**		**P>|z|**
Years of schooling	0.031685		0.000
Working in job for which trained	0.269463		0.000
Log of annual earnings	18.31786		0.000
Square of log of annual earnings	-1.36237		0.000
Cube of log of annual earnings	0.033696		0.000
Adjustment for missing earnings data	81.50847		0.000
Average productivity of the self-employed without employees	-13.4977		0.000
Square of the average productivity of the self employed	0.563593		0.000
Share of service sector employees in the parish of residence	0.993961		0.000
Self-employment rate in the parish of residence	-0.48668		0.043
Unemployment rate in the parish of residence	-1.66399		0.000
Age	-0.12492		0.000
Age squared	0.002138		0.000
Age cubed	-1.3E-05		0.000
Public pipe indoors with running water	0.113294		0.000
Male	0.110109		0.000
Head of household	-0.0578		0.000
In union with wife or live-in partner	-0.07681		0.000
IMR for passing no exams	-1.49287		0.000
IMR for passing only basic CXC or equivalent	-5.08871		0.000
IMR for holding degree or higher professional qualifications	-1.62601		0.031
Legislators, senior officials and managers	-0.86324		0.000
Skilled agricultural and fishery workers	-1.99979		0.000
Craft and related trade workers	-0.97625		0.000
Plant and machinery operators and assemblers	-0.84872		0.000
Elementary occupations	-0.24184		0.000
Mining	1.451662		0.000
Non-metal manufacturing	0.482488		0.000
Manufacturing of metals	0.261142		0.000
Electricity, gas and water	1.250387		0.000
Wholesale and retail trade, hotels and restaurants	-0.54191		0.000
Community, social and personal services	-0.37367		0.000
Constant	9.113895		0.659
Linktest results			
predicted dependent variable	0.999818		0.000
square of dependent variable	0.008186		0.311
_cons	-0.0053		0.561

The IMRs from the model of employment status selection are now used as regressors in the model of log earnings. This step effectively treats the ability indicated by exam performance and employment status as endogenous variables that address heterogeneity among persons in the skills market. It also uses the nonlinearity of the IMRs as key contributors to identification of the model of individual earnings. This second stage model is estimated with OLS. The results of the final stage of Model 1 are reported in **Table 4** including the associated Oaxaca decomposition.

The estimates reveal that that the rate of return on schooling for self-employed persons in the market is again not significantly different to zero. Self-employed earnings appear to be governed by the average productivity of the self-employed in the parish. Moreover, self-employed earnings are tied to elasticities less than 1 of the wage with respect to hours worked (0.25) and weeks worked (0.13). The case for a highly inelastic wage response of subsistence labour is strong. By contrast, labour is supplied by paid employees under conditions that include a significant 9% private rate of return. So, while there is also a highly inelastic labour supply response with respect to hours worked (0.19) and weeks worked (0.13), there is a substantial mechanism of substitution of hours with skills and education in the capitalist sector.

The Oaxaca linear decomposition of the difference of earnings also indicates that overall the difference of the mean earnings of the paid employees and the self-employed of about 90% is due to endowments differences and coefficient differences favouring the capitalist sector. The negative difference of coefficients reflects the role of the IMRs but the result is consistent with the finding that, otherwise, differences of schooling and other coefficients favour the capitalist sector. Interaction of the coefficient and endowment differences also matter. The data do not appear to support either the extreme neoclassical inelastic supply or the assumption of competitive conditions in the works of Rosenzweig. The market for labour appears uncompetitive reflecting substantial barriers to movement from self-employment to paid employment status, operating via a signalling and screening mechanism, and the supply of labour from the self-employed is highly elastic but not infinitely so. This is broadly consistent with Lewis' assumption that the productivity of the self-employed shapes a highly inelastic wage response to the supply of labour; which is also evidence of the slight positive slope predicted by Cumper for the static context. The extreme infinite inelasticity of wage response assumed by Lewis is somewhat strong in the modern environment but then that was purely a convenient simplification.

Table 4: Comparison of the estimated (OLS) earnings functions of paid employees and the self-employed, 2001				
	Paid employees, Private		**Self-employed**	
	Number of obs =17026		Number of obs = 11450	
	F(21, 17004) = 343.17		F(21, 11428) = 454.81	
	Prob > F = 0.0000		Prob > F= 0.0000	
	R-squared = 0.2977		R-squared = 0.4553	
	Adj R-squared = 0.2968		Adj R-squared = 0.4543	
	Root MSE = 0.62309		Root MSE = 0.72454	
Lunywage	**Coef.**	**P>|t|**	**Coef.**	**P>|t|**
delta1	1.588978	0.000	-3.824038	0.000
years of schooling	0.0873778	0.000	0.0014125	0.647
experience	0.0268354	0.000	0.0376852	0.000
experience squared	-0.0002795	0.000	-0.0004887	0.000
log(hours worked)	0.1879337	0.000	0.2480917	0.000
tenure as indicated by log(weeks worked)	0.1298999	0.000	0.131904	0.000
log of average productivity of the self-employed in parish of residence	0.1825918	0.000	0.6347986	0.000
mean years of schooling in parish of residence	0.0579996	0.001	-0.4310202	0.000
male	0.1849403	0.000	0.1053665	0.000
head	0.1012841	0.000	0.0786662	0.000
Spouse	0.1423113	0.000	0.087496	0.004
union	0.0797515	0.000	0.1598076	0.000
chronic disease dummy	-0.1317506	0.000	-0.1373632	0.000
own home of residence	0.0450356	0.000	0.0461178	0.002
Agriculture	-0.1180476	0.000	0.324648	0.000
Mining	-0.0306432	0.457	-1.144358	0.000
Non-metal manufacturing	-0.2723343	0.000	-0.5197272	0.000
Manufacturing of metal products	-0.0427535	0.288	-0.4267776	0.000
Electricity, gas, water	-0.0068287	0.909	-1.040389	0.013
Wholesale, retail, hotels, restaurants	-0.0743675	0.000	-0.0609401	0.017
Community, social and personal services	-0.124123	0.000	-0.0637002	0.013
constant	4.882592	0.000	11.36191	0.000
Linear decomposition of the difference of log(annual earnings) of paid employees and self-employed				
Mean prediction Paid Employees = 12.33949		Mean prediction Self-employed = 11.69992		
	Coef.			**P>|z|**
difference	0.639574			0.000
Three-fold Linear decomposition				
endowments	4.477432			0.000
coefficients	-1.51954			0.000
interaction	-2.31832			0.000

Model 2 – Accounting for the Loss of Case Independence with a Two-Level Mixed Linear Hierarchical Model

By the form of equation (11), the estimation method should also consider the consequences of regressing individual earnings outcomes on reference group characteristics. The method of Model 2 is to assign the group mean characteristics to all workers. One consequence is the breakdown of the standard OLS assumption that the observations based on these grouped individuals are independent, leading to standard errors that are too small and favour rejection of the null hypothesis. Another consequence is that group and individual effects on individual earnings become entangled.

Hierarchical modelling is a way out, especially since it requires very few assumptions regarding the underlying data-generation process (Bryk and Raudenbush, 1992; Osborne, 2000). It is more general than linear regression in that it fits a multilevel hierarchical linear mixed model that allows for fixed effects at the individual level and random intercept and slope effects at the levels of the sociological groups of interest. The groups of interest in this case are the employment groups, in particular the capitalists and the self-employed. We include persons in the government sector as a third employment subgroup to facilitate convergence of the model.

Considering individuals in each level 1 employment group $i = 1..M$, the specific model fitted is the one-level system

$$\begin{aligned} \ln(\text{annualearnings})_{ij} &= \beta_0 + \beta_1 s_{ij} + \beta_2 \text{Exp}_{ij} + \beta_3 \text{Exp}_{ij}^2 + \beta_4 \ln\text{hrswkd}_{ij} + \beta_5 \ln\text{weekwk}_{ij} \\ &+ \gamma_{0i} + \gamma_{1i} s_{ij}^{(1)} + \gamma_{2i} \text{Exp}_{ij}^{(1)} + \gamma_{3i} \text{Exp}_{ij}^{2(1)} + \gamma_{4i} \ln\text{hrswkd}_{ij}^{(1)} + \gamma_{5i} \ln\text{weekwk}_{ij}^{(1)} \\ &+ \varepsilon_{ij} \end{aligned} \tag{16.}$$

It is assumed that γ_i is normally and independently distributed with unique constant variance. The first row of (16) describes the fixed effects assumed to be common to all employment groups. The second row describes the employment group random (coefficient) effects, assumed to add random variation to the level-1 *βs* by employment status. It describes the difference of the overall mean (fixed effects) in row 1 and the mean of group *j* in row 2. It is assumed that the error components in the second and third row of the linear mixed model each has a normal distribution with zero mean and constant variance, so concern is primarily with the variance of the between group means in the second row. A finding of a non-zero variance on the relevant variables lends validity to the results of model 1. The model is fitted using the maximum restricted likelihood (REML) and general maximum likelihood routines of STATA 9.2. To test the significance of the random effects, we first fit a mixed model with random intercepts only at the level of employment status, followed by a full mixed model with both random intercept and slope coefficients at the level of employment status.

The results of estimation are reported in Tables 5. The fixed effects estimates are shown for the case of random intercepts only as well as for the fixed and random coefficients. The likelihood ratio test comparing the random intercepts only model to OLS is highly significant for the census data. When the random slope coefficients are allowed into the model under the assumption of an independent covariance structure, the fixed effects remain broadly similar to those of the random intercept model. The estimate of returns to years of schooling in both models approximates that reported from Model 1 for paid employees when the model accounts for non-random selection. The estimated coefficients for the mean income of the self-employed and the average education stock also convey similar data. Most important, Model 2 indicates strongly significant random coefficients for years of schooling and hours worked as the employment status of workers vary. The likelihood ratio tests confirm this claim, favouring a model that allows for a random group regression function over one that allows only a random shift.

Table 5: Mixed-effects REML regression of Log(annual wage)					
Group variable: employment status; Number of obs = 35696					
Random Intercept Only Model			**Random Intercept and Slopes Model**		
Wald chi2(7) = 7676.68			Wald chi2(7) = 2048.74		
Prob >chi2 = 0.0000			Prob > chi2 = 0.0000		
Log restricted-likelihood =-41057.7			Log restricted-likelihood -40938.4		
Log(annual earnings)	**Coef.**	**P>|z|**	**Log(annual earnings)**	**Coef.**	**P>|z|**
Years of schooling	0.098075	0.000	Years of schooling	.1019579	0.000
Potential experience	0.020123	0.000	Potential experience	.0211211	0.000
Potential experience squared	-0.00032	0.000	Potential experience squared	-.0003455	0.000
Log(hours worked per week)	0.307695	0.000	Log(hours worked per week)	.3184714	0.000
Log(weeks worked per year)	0.148909	0.000	Log(weeks worked per year)	.1465197	0.000
Mean wage of the self-employed	0.430827	0.000	Mean wage of the self-employed	.4389115	0.000
Mean years of education in parish of residence	0.128825	0.000	Mean years of education in parish of residence	.1229468	0.000
_constant	2.866036	0.000	_cons	2.726607	0.000
Random-effects Parameters					
Random Intercept Only Model		**Estimate**	**Std. Err.**	**95% Conf. Interval**	
Employment status: Identity					
sd(_cons)		.2865869	0.143421	0.107468	0.76425
sd(Residual)		.7633995	0.002858	0.757819	0.769021
LR test vs. linear regression		chibar2(01)=2263.83		Prob >= chibar2= 0.0000	
Random Intercept and Slopes Model		**Estimate**	**Std. Err.**	**95% Conf. Interval**	
Employment status: Independent					
sd(years of schooling)		.034226	0.01727	0.01273	0.092017
sd(Log(hours worked per week))		.0688913	0.038217	0.023226	0.204342
sd(Log(weeks worked per year))		.0169796	0.023069	0.001184	0.243436
sd(_cons)		.3708479	0.202235	0.127353	1.079899
sd(Residual)		.7606716	0.002848	0.755111	0.766273
LR test vs. linear regression		chi2(4) = 2502.38		Prob > chi2 = 0.0000	
Likelihood-ratio test random intercept nested in random slope		LR chi2(3) =238.55		Prob > chi2 =0.0000	

*sd=standard deviation

Summary and Discussion

The main result of the estimation is that individual earnings of both the self-employed and the paid employees in the capitalist sector depend on the average productivity of activity in the subsistence economy. However, the earnings of the self-employed depend *only* on the average productivity of the self-employed. The mixed linear hierarchical model adjusts for likely interdependence of cases but still shows results consistent with this argument, emphasizing that there is likely to be considerable diversity among employment groups. This is consistent with the result that the self-employed are generally disadvantaged in the capitalist market for skills. These results imply Lewis' claim that the average productivity of the self-employed tends to operate as an effective floor to the capitalist wage. Thus, the capitalist wage for relatively unskilled labour has a relatively inelastic response to changes in the supply of labour at any time. This result is nevertheless consistent with the Cumper's argument that the time-indexed supply elasticity of labour is not likely to be strictly infinite as the average subsistence productivity might change over time. Lewis specific assumption of surplus labour conditions in Jamaica over time is a plausible simplification of that condition, especially if the labour force participation rate adjusts appropriately.

Another result is that there exist non-competitive conditions in the market, with differences of coefficients playing a significant role in explaining differences of log (annual earnings) of these sectors. This result points to likely screening, costs, limited supply of places and other general barriers to movement of the self-employed into the capitalist market. Further, there are also strong indications of externalities, especially pecuniary externalities transmitted through the average productivity of the self-employed and the average level of education in the parishes. These provide an additional resource replacing "cheap" labour under conditions of highly elastic supply and suggest that profits and the saving rate can be made to grow by creating new domestic capital with domestic capital and the highly elastic labour supply.

The most important implication of these empirical findings is that the set of techniques underlying economic choice is sparse in Jamaica, mainly because of the underdevelopment of the real domestic capital market. An underlying inadequate supply of capital in the economy creates a marginal product of labour function that is initially low and falls off rapidly to the average product of subsistence workers as employment grows. Accumulation and employment in the capitalist sector are not sufficient to clear or equilibrate the labour market. A related implication is that capital accumulation is not automatically generated by the capitalist market or by monetary policies that seek to alter interest rates and the money supply in order to make other techniques accessible and attractive. The accessible set includes the subset that can be adopted from abroad if domestic tacit knowledge is adequate, relevant and suitably dynamic. Accumulation on that basis requires existence of a domestic capital sector that produces a sufficient range of domestic capital that makes the available set of techniques increasingly dense, at least substantially more so than at present. The growth of the capital stock must be faster than the growth of output, which implies that the capital component of output must also grow

faster than all other components. On that basis, the domestic capital stock drives up output at a sufficient rate for employment to grow relative to the size of *the labour force* and for the employment rate to drift towards full employment. While all forms of capital are important, development of the necessary domestic capital sector most crucially requires investment to develop, codify and make explicit and thus to employ the tacit knowledge capital of economy. Such development is blocked by the traditional sociology of race and colour in the class formation process and the dominance of historical business practices that emphasise survival rather than advancement strategies in the capitalist sector and that diminishes the role of domestic tacit knowledge in the business process. Suitable policy and planned intervention is needed to address such conditions.

Investment to develop the domestic capital and tacit knowledge that widen the available set of techniques may also be seriously restrained by independent artificial increase of the living standards of the subsistence sector through redistributive measures unrelated to the profitability of the investment to increase the density of the existing choice set. This is consistent with the lack of robust and consistent growth and development in Jamaica in the context of strong redistribution and poverty reduction programming since the liberalisation era of the 1980s. At the same time, since techniques include both domestic and imported capital, the results also imply that conditions exist for profitable domestic capital production and accumulation with possible increase of per capita consumption opportunity, if engineered by appropriate policy to restrain the rents on imported capacity. Suitable policy will include expansion of the money supply through credit for **both** working and fixed domestic capital production and investment.

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[i] That is, foregone earnings as a share of potential earnings.