STRATHCLYDE

DISCUSSION PAPERS IN ECONOMICS

HUMAN CAPITAL IN ECONOMIC DEVELOPMENT: FROM LABOUR PRODUCTIVITY TO MACROECONOMIC IMPACT

BY

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NO 15-01

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Human Capital in Economic Development:
From Labour Productivity to Macroeconomic Impact

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Abstract

Micro-econometric evidence reveals high private returns to education, most prominently in low-income countries. However, it is disputed to what extent this translates into a macro-economic impact. This paper projects the increase in human capital from higher education in Malawi and uses a dynamic applied general equilibrium model to estimate the resulting macroeconomics impact. This is contingent upon endogenous adjustments, in particular how labour productivity affects competitiveness and if this in turn stimulates exports. Choice among commonly applied labour market assumptions and trade elasticities results in widely different outcomes. Appraisal of such policies should consider not only the impact on human capital stocks, but also adjustments outside the labour market.

Acknowledgements:

1. Introduction

A well-known empirical conundrum is that micro and macro impacts of human capital are not consistent. Microeconometric evidence suggests bigger impacts than does some macroeconometric work (Pritchet 2001). That is to say, the sum of the individual impacts is apparently larger than the economy-wide impact. This has been flagged up as one of the major gaps in education economics (Psacharapoulos and Patrinos, 2004) and fostered a degree of scepticism about the macroeconomic contribution of education (Benahabib & Spiegel 1994, Pritchett 2001). Significant efforts have gone into explaining this via statistical/measurement issues (Hanusheck and Woessman 2008, Krueger and Lindahl 2001, McMahon 2000, Schoellman 2012), but less attention has been given to the transmission mechanism from a micro to macro impact (Sianesi and van Reenen, 2003). For low income countries the high returns found in micro studies suggest increasing access to higher education could have an important economic impact. However, as Chirwa & Matita (2009) point out, it is often perceived as a luxury in this context. Therefore, it is important both from academic and policy perspectives, to understand under what conditions the micro impacts of education are transformed into a macro impact.

Addressing this gap requires analysing both what occurs in the labour market as well as the transmission mechanism from the labour market to the wider economy. In this paper the focus is on the interaction between the labour market and the wider economy, in particular the interaction of human capital with investment and trade. For this we draw on microeconometric evidence to calibrate the change in human capital following an increase in the number of graduates in the labour market as a change in effective labour supply. A dynamic applied general equilibrium model is constructed for Malawi, a small country in Sub-Saharan Africa, in order to simulate endogenous adjustments and the resulting macroeconomic impact[1]. Malawi is a good case study due to the availability of comprehensive information on returns to education in market employment and self-employment from the 2004/05 national household survey (Chirwa & Matia 2009, Matita & Chirwa 2009) and a 2004 Social Accounting Matrix (SAM)[2].

Simulations are carried out under a combination of two common labour market specifications and two sets of parameter estimates for the price sensitivity of exports. Under this narrow range of plausible assumptions the projected increase in human capital results in widely divergent macro impacts. The outcome is driven by the trade

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[1] This is similar to the approaches used by Giesecke & Madden (2006) for Tasmania and Hermannsson et al (2013) for Scotland.

[2] The SAM was constructed by the World Bank and was generously relesead to use for use in this project. We are grateful for the assistance of Tim Gilbo the then head of the World Bank's Malawi office and the World Bank modelling team for their assistance.

mechanism, but exacerbated by the labour market specification. Therefore, we argue that studying labour market issues in isolation is insufficient to determine the development impact of human capital policies, but that analyses need to incorporate the micro-macro transmission mechanism, in particular trade. Existing micro-econometric literature provides a range of estimates for the potential labour market impact. However, our findings suggest that for the macroeconomic outcome, more significant contingencies result from uncertainty about the 'knock-on' impacts of labour productivity stimulus. The next section briefly summarises previous research. The third section illustrates the projection of the human capital stock. The fourth presents the modelling strategy and macroeconomic data used. The fifth section presents and discusses the results. Brief conclusions are presented in the sixth section. Model details are outlined in appendix.

2. The wage premia as an indicator of labour productivity

An extensive microeconometric literature documents the rates of return to education at various levels of schooling, in different countries at different times. These studies reveal a clear association between education and wages. typically finding high returns in low income countries (see Psacharopoulous and Patrinos, 2004, for a survey). For example, recent estimates for Malawi finds that graduates earn approximately three times as much as those with primary qualifications (Chirwa & Matita, 2009, Table 3, p. 12).

Due to an inability to conduct controlled experiments in the field, verifying the causality between education and income is difficult. Interpreted in the spirit of the human capital school (Becker 1964, 1975 Mincer 1958, Schultz 1960) education directly increases human capital, which in turn increases the productivity of workers. An alternative view is motivated by the theory of signalling and screening (Arrow 1973, Spence 1973, Stiglitz 1975), which maintains that *in extremis* education does not enhance human capital (and as a consequence productivity), but simply serves the purpose of revealing innate ability to employers (for an overview see Brown & Sessions 2004). A range of statistical approaches have been applied to address this conundrum, such as utilising natural experiments (Krueger & Lindahl 2001, Card 2001) and controlling for fixed effects using twin samples (Bonjour et al 2003, McMahon 2009 Appendix A). The current consensus view is that education affects income per se but is not just a proxy for unobserved ability (Blundell et al 2005, Card 1999, 2001, Harmon & Walker 2003). There is likely to be some role for signalling, but of modest magnitude relative to overall impacts (Lange & Topel, 2006).

The current consensus is based on empirical evidence from market employment in high income countries. However, drawing on the link between education and output

in self-employment can be more representative for low income countries (Joliffe 2004, Soon 1987). Focussing on the self-employed has the added benefit of circumventing the influence of labour market signalling (Heywood & Wei 2004). Matita and Chirwa (2009) analyse the productivity of the self-employed by level of education for several occupations in Malawi, based on the 2004-05 integrated household survey (NSO, 2005). They find higher education to have the most modest impact for Maize growers, being on average 68% more productive than those with primary qualifications (Table 2, p. 15), while higher education has a more significant impact for tobacco growers, being 136% more productive than those with primary qualifications (Table 3, p. 16). The biggest impact is felt for enterprise earnings, where self-employed graduates earn more than 3 times that of those with primary school qualifications (Table 4, p. 18). Looking at the self-employed as a whole they find that on average self-employed graduates earn about 2.5 times that of those with primary qualifications. Conversely, for market employment graduates earn about 3 times that of those with primary qualifications. If the difference between the two estimates is interpreted as a signalling effect this would suggests the wage premia of graduates in market employment, overstates the productivity benefits of higher education by about 20%. This is bigger than typically found in high income countries (see Hermannsson et al (2013) for a discussion).

If conducting a growth accounting exercise, an increase in the education adjusted labour supply would simply mean more inputs into the labour component of the production function, which in turn would suggest more output. Although this suggests a clear and intuitive causal mechanism, the approach rests on strong assumptions and is further undermined by weak and conflicting empirical findings. Macroecometric studies based on cross country regression have provided mixed results on the macroeconomic impact of education and some authors are highly sceptical (Benhabib & Spiegel 1994). Sianesi & Van Reenen (2003) survey over 20 macro growth regressions and argue that overall these support the qualitative notion that human capital stimulates growth, but in light of methodological complications they urge caution in using results to quantify the magnitude of such links.

In light of this apparent mismatch between the empirical estimates of the impacts of education at the micro and macro levels it is worthwhile exploring the transmission mechanism from the micro impact, the productivity stimulus to the individual as manifested in earnings regressions, to the impact on macroeconomic aggregates. Although there is certainly room for debating the accuracy of wage premia as a proxy for labour productivity, this may not be the weakest link in the chain. A wide range of microeconomic evidence underpins a link between education and productivity. However, a neglected aspect is how labour productivity translates into

macroeconomic impact. For this a range of contingencies are plausible, which can qualify the final outcome.

3. Human capital projection

The stock of human capital is calculated following a standard approach from growth accounting, where supply of labour at different skill levels is aggregated into a single stock of human capital, constructed as efficiency units of labour. Following Acemoglu & Autor (2012), for two types of labour unskilled (*N*) and skilled (*H*) the human capital stock in efficiency units can be presented as:

$$Z = N + \frac{W_H}{W_N}H = N + wH$$

where W_H is the wage of high skill workers, W_N is the wage of unskilled workers and $w = {W_H}/{W_N}$ is the wage premia of high skill workers.

Population and human capital stocks are fixed, except for graduates from higher education, which enter the labour market at the rate of graduation exhibited by the higher education system in 2004. Every time period the oldest age cohort of workers retires. This contains a smaller share of tertiary graduates than the new cohorts and hence gradually over time the human capital stock expressed in efficiency units increases until it reaches a steady state where the number of tertiary graduates entering the labour market equals the number of those retiring.

The wage premia of skilled workers is obtained from Matita & Chirwa (2009), who examine the return to education among the self-employed. The least skilled workers equal one efficiency unit, whereas the wage premium of graduates with tertiary education makes them equivalent to 4.18 efficiency units. This indicates a significant productivity differential between the least skilled and the most skilled. However the base of tertiary skilled workers is very small (0.4%) so the overall impact is modest – a 0.25% long run increase in effective labour supply.

4. Macro data and modelling approach

Endogenous adjustments following an increase in the human capital stock are simulated using an applied general equilibrium model with forward looking agents. The model is an applied and extended version of the skeletal model by Abel and Blanchard (1983). Investment decisions follow a Tobin's *q* adjustment (Tobin, 1969) and are separated from savings decisions. It has three sectors: Agriculture,

Manufacturing and Services; and three domestic institutions: households, firms and government. The Rest of World (ROW) is considered exogenous and trade is price sensitive. Details of the model are presented in Appendix and model code can be supplied upon request. The model is calibrated on a 2004 Social Accounting Matrix (SAM)[3]. The simulation invokes a Harrod neutral productivity change, equal to the 0.25% increase in effective labour supply reported in the previous section (i.e. an increase of the coefficient A in equation A6).

The analysis focusses on two contingencies in the transmission from a micro level increase in human capital to macro level output; the extent to which increased labour productivity affects competitiveness; and the degree to which competitiveness stimulates exports. To this end a comparison is made between the impacts of human capital under two commonly applied labour market assumptions: a fixed nominal wage and a wage curve (Blanchflower and Oswald, 1995), where the real wage responds to the local rate of unemployment. The latter specification is frequently used for high income countries but empirical work suggest it is appropriate for low income countries (see e.g., Hoddinott, 1996). Furthermore, the model is solved using two alternative parameter estimates for the price sensitivity of exports. The higher elasticity (4) was estimated for the World Bank Linkage model and the lower one (3) for the Global Trade Analysis Project GTAP (Andersson & Martin, 2006, Table 12A.2, p. 392).

5. Simulation Results

Table 1 shows the short-run and long-run impacts. The first two columns report results obtained under real wage bargaining, whilst the last two columns show results under fixed nominal wage. Starting with the real wage bargaining results, in the short run GDP increases slightly with respect to the initial steady-state. In this time frame, the increase in efficiency generates a reduction in employment reflecting fixed sectoral capital stocks in the first period. The increase in labour efficiency pushes down the demand for labour so that, given fixed labour supply, unemployment rises putting downward pressure on real wages.

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[3] The SAM was constructed by the World Bank and was generously relesead for use in this project. We are grateful for the assistance of Tim Gilbo the then head of the World Bank's Malawi office and the World Bank modelling team for their assistance.

Table 1. Simulation results. Short run (SR) and long run (LR) impacts under Real Wage Bargaining (RWB) and Fixed Nominal Wage (FNW) (%-change from base year).

	RWB		FNW	
	SR	LR	SR	LR
GDP	0.001	0.489	0.149	1.187
Consumer Price Index	0.181	-0.050	0.410	-0.122
Unemployment Rate	0.063	-2.197	-2.634	-9.569
Total Employment	-0.006	0.217	0.260	0.946
Nominal Wage	0.175	0.172	0.000	0.000
Real Wage	-0.006	0.222	-0.408	0.122
Replacment Cost of Capital	0.207	-0.048	0.488	-0.115
Population	0.000	0.000	0.000	0.000
Consumption	0.405	0.391	0.960	0.949
Capital Stock	0.000	0.460	0.000	1.117
Export	-0.324	0.169	-0.637	0.409

In the long run the reduction in the cost per efficiency unit of labour stimulates economic activity through its impact on commodity prices, and this in turn stimulates the demand for both labour and capital services. The downward pressure on prices further provides a positive stimulus to consumption and investment. The long-run reduction in prices (see for example the change in CPI and replacement cost of capital) stimulates exports to the Rest of Word (ROW).

With fixed nominal wage, the level of economic activity increases in both time periods. The changes in GDP, employment and consumption are higher compared to the case of real wage bargaining in the short and in the long-run. With nominal wage fixed, employment increases even in the short run. Furthermore, the change in employment is higher than the change in GDP. This means that the capital/labour ratio falls in the short-run, whereas it increases for the case of real wage bargaining. However, with long run adjustment the capital/labour ratio increases in both labour market closures, as a consequence of a greater increase in labour efficiency.

The short-run impact is larger under fixed nominal wages than the real wage bargaining case. This is generated by a bigger substitution effect in favour of labour. In the long-run, with total adjustment in capital stock, the nominal wage rigidity provides an additional improvement in competitiveness generated by a bigger fall in prices, which stimulates export demand for local goods. Ultimately, it is the larger

increase in exports that determines a bigger long-run impact under the fixed nominal wage.

Figure 1 Comparion of projected GDP changes under alternative assumptions about labour markets and price elasticity of exports (% change from base year).
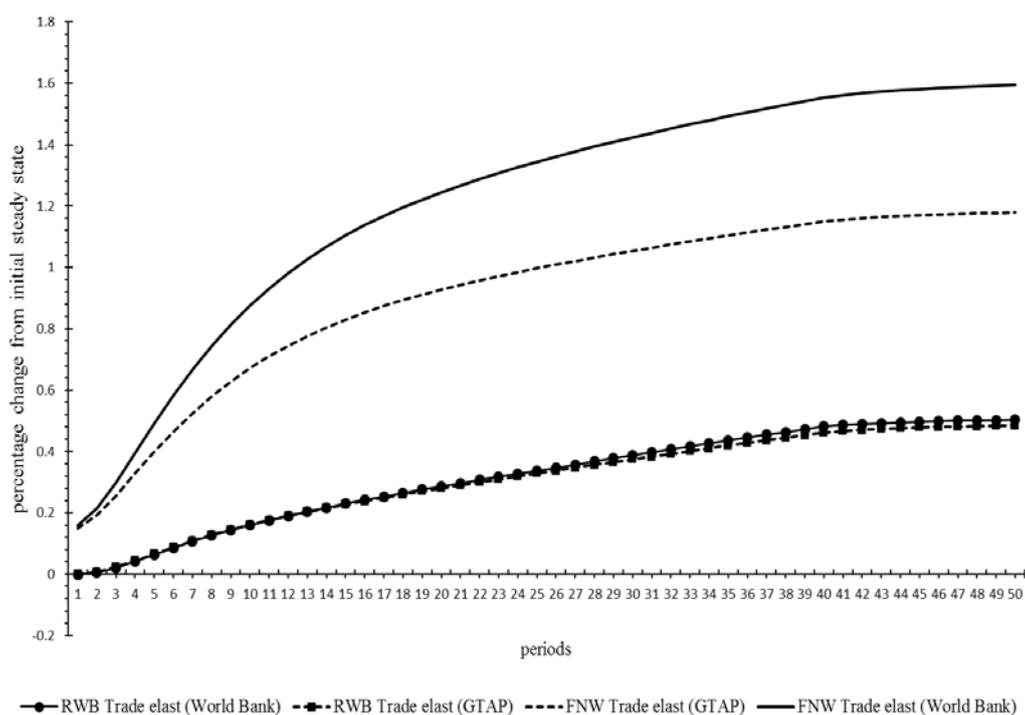
The results in Table 1 show that competitiveness effects are a key element in realising the macroeconomic impact of human capital. Therefore, it is important to consider the sensitivity of the impact to different estimates of the trade elasticity. Figure 1 reports the period by period percentage change in GDP obtained by performing the same shock described above but varying the trade elasticity. For both labour market closures an increase in the trade elasticity provides a bigger increase in output. However, for the case of fixed nominal wage we observe a dramatic increase in GDP when trade elasticities are higher compared to the case where wage bargaining is adopted.

This suggests that if wages are flexible and depend on the excess demand for labour, the impact of a labour productivity shock is insensitive to change in trade elasticity.

The competitiveness effects, in this case, are partially offset by an increase in wage income. This would not occur if the Malawi economy was able to attract skilled migrants. In this case migration would put downward pressure on wages thus increasing competitiveness effects. Conversely, the competitiveness effect is conditional on the assumption that labour efficiency is improving in Malawi relative to the rest of the World (ROW). If the ROW is experiencing similar increases in productivity, the competitiveness advantages would, of course be muted (but offsetting what would otherwise be a decline competitiveness).

6. Conclusions

This paper analyses the macroeconomic impact of human capital accumulation. The aim is to provide a simple demonstration of the potential influence of the transmission mechanism when estimating the macroeconomic impact of an increasing human capital stock. Microeconometric evidence and a growth accounting framework are used to determine the change in effective labour supply, while a general equilibrium model is used to simulate endogenous adjustments. This reveals that a positive outcome is driven by competitiveness effects boosting exports. A key transmission mechanism is the interaction between labour markets and trade, which makes the overall outcome contingent upon two steps: labour productivity increasing competitiveness and competitiveness stimulating exports. This suggests that the effectiveness of human capital investment for economic development could be complemented by policies that affect the export elasticity by reducing trade costs, such as through reducing physical and institutional transport barriers (see e.g. Freund & Rocha 2011, Limão & Venables 2001).

Undoubtedly determining the productivity stimulus of human capital precisely is important for the accuracy of the overall analysis. However, the potential margin of error is hardly a matter of priority relative to significant contingencies in the micro-macro transmission mechanism, which are less well understood. The analysis presented here reveals that the macroeconomic outcome of a human capital accumulation progress can be affected by orders of magnitude, depending on how the increase in effective labour supply is transmitted and what endogenous adjustments take place in the rest of the economy.

The analysis can be extended in a number of ways. Firstly, the economic impact of graduates is largely driven by increased competitiveness, with subsequent employment and output impacts critically depending on stimulus to exports.

Therefore, it is not sufficient to analyse a locality and its policies in isolation as outcomes depend on the simultaneous developments in competing cities, regions and nations. An increase in productivity, by and of itself, does not improve competitiveness, unless it is greater than that of trade partners. This is demonstrated for the impact of demographic changes in a multi-country analysis by Mérette & Georges (2010), but has so far not been taken into account when examining the economic impact of human capital. Secondly, this analysis only pertains to labour supply and does not allow for other supply-side transmission mechanisms, such as social returns and non-market private returns (McMahon, 2000). Finally, in order to gauge the per capita impacts of the education system it is important to consider its economic impacts in the context of demographic change. This is particularly important for low-income countries, such as Malawi, which exhibit fast population growth. Indeed, the higher education sector in Malawi has expanded since the base year used here, but so has the population. Therefore, it is not clear a priori whether production and retention of graduates will keep up with population growth to maintain a constant or growing share of graduates in the work force. Therefore, policy analysis would benefit from a framework that explicitly acknowledges population structure, such as in an Overlapping Generations (OLG) model.

Appendix: Summary of model

This appendix elaborates on some of the features of the dynamic applied general equilibrium model used for simulations in this paper. Inevitably due to space constraints the presentation is not exhaustive, but further details of model equations and calibration, as well as the model code, are available upon request.

The decision problem of the representative consumer is to choose a sequence of consumption that maximizes the present value of utility, as summarized by the lifetime utility function:

$$U = \sum_{t=0}^{\infty} \left(\frac{1}{1+r} \right)^t \frac{C_t^{1-s} - 1}{1-s} \tag{A1}$$

where C_t is the consumption at time period t, s and r are respectively the constant elasticity of marginal utility and the constant rate of time preference. The dynamic budget constraint ensures that the discounted present value of consumption must not exceed total household wealth, W:

$$\sum_{t}^{\infty} m(t) Pc_t C_t \pounds W \tag{A2}$$

where Pc is the household's aggregate consumption price index and given r the interest rate, $m(t) = \prod_t (1+ r_t)^{-1}$. Once the optimal path of consumption is obtained from the solution of the intertemporal problem, aggregate consumption is allocated between sectors through a constant elasticity of substitution (CES) function. Household demand for local and imported goods is a result of the intra-temporal cost minimization problem.

The path of investment is obtained by maximizing the present value of the firm's cash flow (Hayashi, 1982) given by profit, p_t, less private investment expenditure[4], I_t subject to the presence of adjustment cost $g(x_t)$ where $x_t = I_t / K_t$ (Devarajan & Go, 1998):

$$\sum_{t=0}^{\infty} \frac{1}{(1+r)^t} \left[p_t - I_t \left(1 + g(x_t) \right) \right] \quad \text{subject to} \tag{A3}$$

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[4] For simplicity of notation the sector index is omitted. Furthermore, variables not defined over time with the subscript t are assumed to be fixed throughout.

$$\dot{K}_t = I_t - \delta K_t \tag{A4}$$

The solution of the dynamic problem gives the shadow price of capital, λ_t and the time path of investment.

Total gross output X, is given by combining value added (Y) and intermediate inputs (V) through Leontief technology:

$$X_t = \min\left\langle \frac{Y_t}{a^Y}; \frac{V_t}{a^V} \right\rangle \tag{A5}$$

where a^Y and a^V are input coefficients. Y is given by a CES combination of labour (L) and private capital (K):

$$Y_t = \left[a(K_t)^J + (1 - a)(A_t L_t)^J \right]^{\frac{1}{J}} \tag{A6}$$

where $A_{i,t}$ is an index of Harrod neutral technical change and given y the elasticity of substitution, $J = (y - 1)/y$. The demand for labour and capital is obtained from first order conditions .

Imported and locally produced intermediate goods are considered imperfect substitutes and are combined under a CES function (Armington, 1969). The demand function for intermediate inputs derives from cost minimization. Each industry produces goods and services that can be exported or sold locally. An export demand function closes the model where foreign demand for Malawi goods (E) depends on the ratio between the ROW price (Pe) and the price of output (Px), and the export price elasticity, h:

$$E_t = \bar{E} \left[\frac{Pe}{Px_t} \right]^h \tag{A7}$$

Government taxes labour income ($t^L Ly$) and capital incomes ($t^K Ky$). Its expenditure comprises current spending in goods and services (G), net transfer to households (Tr) and interest payment on debt ($r \times D$).

$$\dot{D}_t = rD_t + G_t + Tr_t - t^L Ly_t - t^K Ky_t \tag{A8}$$

As this application does not consider changes in natural population, labour force is fixed to the base year. The model is run under two specific labour market closures:

fixed nominal wage (FNW) and real wage bargaining (RWB). In the latter case, real wage and unemployment are negatively related as in Blanchflower and Oswald (1995):

$$\ln\left[\frac{w_t}{cpi_t}\right] = c - 0.1\ln\left(u_t\right) \tag{A9}$$

where c is a calibrated parameter, w, cpi, and u are the nominal wage, the consumer price index and the unemployment rate respectively. In the real wage bargaining regime wages are directly related to workers' bargaining power and respond to excess demand for labour.

The total absorption equation provides equilibrium in the commodity market. This is sufficient to guarantee equilibrium in the payments account since money is not considered as a commodity. In the capital market, capital demand equals the capital stock. Equilibrium in the labour markets is achieved through changes in unemployment rate, as the wage rate is not determined via first order conditions.

Table A1. Selected benchmark values

Investment/GDP	0.16
Capital-Labour ratio	0.79
Export/Output	0.12
Import/Export	1.97
Constant elasticity of marginal utility	1.20
Interest rate	0.04
Depreciation rate	0.15
Wage curve elasticity	0.10
Trade elasticity	3 (4)
Production elasticity	0.30

Share parameters are obtained from the SAM while some structural and behavioural parameters are based on econometric estimation or best guesses. Some selected benchmark values are reported in Table A1. To solve an infinite time horizon model steady state conditions are imposed at a specific point in time. Hence the transitional pathway is the result of the discrete time solution of the model.

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