Review of: "General Equilibrium Effects of Investments in Education, and Changes in the Labor Force Composition"

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Potential competing interests: No potential competing interests to declare.

Reiteration of framework and results

- education spending is assumed to be skill-set adding ,hence contributing to the unchanged number of workers putting in similar hours but generating more output (more productive) . Education spending thus, increases labor efficiency which impact on production value based on skillset intensity of the sector and income elasticity.

-labor cost calculated from education output value and labor cost (physical capital assumed constant). The argument is that improvement in the use of existing capital that is effected through improvement in labor quality and skillset acquisition. Sectors that have low skill intensity do not get as much benefits of education spending as those that have high intensity in skillsets hence while experience price decline due to increase in quality labor supply, the increase in income fails to compensate for the decline (overall negative association between education spending and production.

-is the inverse relationship between spending on education and prices of primary factors, identified in the agricultural and unskilled labor category, attributable to relative spending on education by category of employment   category or a dynamic that runs from increased education spending, to improvement in labor quality/skillsets, inducing a shift or movement in employment category away from one where benefits of high skills are lowest to those where they are highest as reflected in wages earned/incomes?

On critical hypotheses:

*- **b**etter quality jobs are available when people get more educated*(is the hypothesis based on theory or empirical research results on developing countries? It must be noted that in early 1970s and 1980s, there an argument that an increase in spending on education especially an elementary level was more important than spending a year on higher education. This argument, was behind the pursuit of Universal education programs funded partially by the World Bank. However, with time it became apparent that spending on primary education through Universal education programs while increased participation rates, adversely affected the quality of education, and students. This is the case in some countries where increased spending contrarily to theory at the time, adversely affected educational quality, skill attainment (low reading, numeracy, socioemotional and life-long skills). It is a problem that continues to affect developing countries that rushed to adopt universal education initiatives. What was forgotten perhaps was that learning is not just sending as many school age children to schools without improving the quality of teacher's pedagogy and wellbeing, available of conducive classrooms, supportive school management, relevant and regular scholastic materials, relevant and flexible and adaptable curricular, performance based teachers incentives including career development and networking etc. Today, it is generally agreed that economic advancement is in part attributable to providing sufficient and sustainable funding to

tertiary educations that create a human resource with creative, innovative, and problem solving skills that serves as an engine that activates , supports ,and continuously renews growth and development path. The skillsets developed should ne aligned with capabilities that are needed to exploit and develop scarce imitable resources a country has which creates a competitive advantage that others find hard to either emulate or imitate. A universally educated general population is required to create an informed electorate to support democracy but that may not be translated into skillsets that have direct impact on a country's sustainable growth and development path.

-technology for educational services is intensive in skilled labor(generally true). However, does data on cost of industrial structure of education service in Ethiopia attest to that assumption?

- If that is indeed the case, impact of educational expenditure on labor supply in agriculture specifically shouldn't it be positive? This is because while educational spending as it relates to agriculture (taking forms of for instance agricultural extension, training), is often associated with mechanization, adoption of improved seed varieties, marketing access etc, it indeed supports an increase in the use of labor especially in developing countries such as Ethiopia that have relatively small plots of land for farming activities. The same also applies to other sectors that use semi-skilled labor such as MSMEs. The question is then is that why does such education spending returns a negative relationship with product prices in the sector? Is it only because of the low skill intensity in the sector, which implies that results maybe different in contexts where agriculture is not of low skill intensity (this raises the generalizability of research findings)

-If indeed that is the case, don't the results reflect more of the differential impact of technology adoption as delivered through education services spending on labor efficiency than on skillset improvement per se? Using technology, often imported and suffers from lacking social, economic, and environmental context relevancy as embedded in education spending as an input into the production process, while maybe relevant to other sectors is not always appropriate to agriculture and semi-skilled job categories. Shouldn't this in part explain the negative relationship between educational spending and labor supply that is shown in agriculture and semi-skilled jobs category?

-higher wages reflecting higher productivity(does assume away the influence of educational attainment on ability to organize and demand higher ages, which would not therefore be a consequence of increased contribution to production value added rather strengthening of bargaining position of workers vis-avis employers thanks to having enhanced capabilities and being better informed of their rights and benefits of associating, and collective bargaining etc)

-The analysis assumes that each category is separate but interdependent in a computable general equilibrium model (CGE), and takes labor and capital constant . How does the above statement reconcile with other parts of the paper that supposedly underscore the importance of maintaining physical capital constant to determine the effect that educational spending has on labor composition in the economy?

On differential impact of education spending across sectors:

-A closer observation of the results on the effect of education spending on labor composition by sector may point to the moderating variable that is influencing the relationship between education spend and labor composition dynamics. Labor efficiency elicits the highest increase in the officials and managers category (17.24%), followed by technicians and professionals (15.57%), service and shop workers (12.41%), clerks by 10.77% and inversely in Agriculture and other

nonskilled workers category(-2.65%). Is it the strong contribution of labor-intensity skillsets that are embedded in education spending to productivity or the technology intensity that characterizes education service that is at play? Controlling entirely for the influence of capital, not only physical , would shed a clear light on this, but absent, there is ambiguity on the contribution that effect of change in labor cost has to the outcomes as opposed to the role that other manifestations of capital, obviously besides physical capital, that remains constant, play.

Pass through process of the impact of education spending (input) to inducing increase in labor efficiency, to social welfare improvement.

-How long does the intertemporal convergence take from the initial education spending to the final equilibrium state? This is important because the assumption is that it should take long for an investment in education (manifested in public spending) to transition from direct impact to the multiplicative impacts that reverberate through all other sectors to create cumulative effects ranging from increase in consumption (demand), increased labor efficiency that reduces prices of products and services, which subsequently triggers an increase in terms of trade, production value, incomes and social welfare.

It is apparent that the impact of educational spend on labor composition by sectors follows skill requirements , with those sectors that require high skills or service oriented, showing results that range fron high to modest positive effects (see variation in prices),while those that produce primary products (Graincrops, meatLsk, and Extraction for instance) return inverse impact (in this case price increase). Perhaps the author should share thoughts on why for brevity's sake, the research did not just create two sectors that is primary ; secondary and service production, which perhaps would have made things simpler and more tractable?

Or alternatively, since as the paper established that spending on education influences sector and industry productivity, competitiveness, terms of trade and demand pattern, isn't the factor of increased capital productivity resulting from better and informed use of technology or total factor productivity a better explainer of the stronger effect of education spending than improvement in skillsets per se? This would mean a moderating variable is at play, which the CGE model didn't incorporate for perhaps for parsimony purposes as the paper elucidates in one section.

On the "the existence of a multiplicative propagation mechanism of investments in education, not its precise quantification."

- Education spending-increase in quality or skilled labor – skilled-labor supply shock-low sector prices due increased efficiency, high valued added, competitiveness, growth, and social welfare.
-the interpretation of the model while appealing and even intuitive, is close to machine learning approach that seeks to obtain the model from the data (though based on previous empirical model I have to admit), rather that using data to test it on the model which is what econometrics and statistical models do. So, the implication is that model generalizability is undermined as the results are data dependent. The excuse that the authors uses, which is to avoid increasing the complexity of the model which would distract readers from the focus of the research which is to determine the change in

spending on education has on the production value , trade, competitiveness, of economic sub sectors may thus not allay such concerns.

-another issue as regards the multiplicative pass through of the impact of educational spending (specifically increase in growth, incomes, and social welfare). Increase in labor efficiency, increase in income, growth, and social welfare is predicated on several assumptions, which may or may not be true, including:

1- trickle down theory of economic growth that links increase in labor share of output directly translates into improvement in share of output value and income;

2-frictionless transfer of earnings to factor of production that generates the most earnings(long proved not true, especially with the pervasive adoption of flexible labor conditions ,weak even non-existing bargaining power of trade unions in not only developed nations but is today a norm in many, if not most developing countries;

3-disentangling national income figures perhaps can determine which factors of production is the main beneficiary of the increase in labor efficiency (capital, state /public sector since Ethiopia, which is the data used in the model remains to a large degree a centralized, semi-planned economy). In other words, theory may not pan out in practice due differences in policy economy considerations and factors influencing freedom of movement and pricing of factors of production etc.

-in relation to the foregoing, since CGE modeling makes it possible to determine policy trade offs, were there trade offs that were identified for instance of investment in education vis avis allocating such expending to infrastructure, direct sectoral production process, transportation etc?

On model assumption and relationships

-The model assumes physical capital constant, which as the paper notes, makes it possible for the author to determine the influence of education spend on cost / efficiency of labor. Even then unchanged physical capital level being complementary to changes in labor increases productivity it is noted. Is it possible to control the effect of capital on labor considering the fact that one the critical hypotheses, the author notes that *education service technology is labor skill intensive?* Keeping physical capital constant but keeping technology variable, cofounds even complicates the relative contribution of labor and capital (non physical part if you may prefer) to production, trade, competitiveness, growth , income and social welfare. This is because I would assume that the increase in worker skillsets, contributes to enhanced capabilities, ability and knowledgeability to use existing capital as embedded in technology employed in the production process (This is the point the author in the assertion on the complementarity of change in labor supply and physical capital in one section of the paper).

-accounting for total factor productivity

The problem perhaps is how to control for alpha or total factor productivity component in the relationship between education spending, labor productivity $\alpha*(L^{\beta} , K^{1-B})$, and output value, which is the largest contribution of increase in output value.

-Increased return on capital, and increase in capital inflows:

Which way is the direction of the impact of the increase in capital inflows on economic growth and income? Complementary /augmenting or reduce the benefits of increased labor efficiency on growth and income through increasing the share of outcomes that goes to capital, domestic and foreign alike?

Implications of research findings

-implications for policy perhaps not highlighted, may include how best to mitigate that regressive or adverse effect of spending on education on benefits generated to beneficiary sectors (appropriateness of educational spending by sector in terms of skillsets promoted). Why shd effective education spending have adverse effect on appropriate labor supply (amount and skillsets)? Do we then see inappropriateness of education spending as far as agriculture and sectors that do not need high skillsets as defined in the model to in part be attributable for the model results? If that is the case, model results can contribute to informing policy on improving education spending effectiveness in developing countries.

-The author cites the importance of using a model that is rooted in the reality of intersectoral interdependence, and identifies another weakness in previous research on education and labor that drew theoretical underpinning from micro economic theory, which were then brought into the CGE. However, it should be even more illuminating for the author to reiterate , apart from adopting previous CGE model , the most important contribution the research and its findings make to current knowledge and practice on the relationship between education/human capital and employment in developing countries.

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