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Determinants of Productivity

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Abstract
Due to lack of reliable data, combined factor productivity has not yet been computed in developing countries on non erroneous bases. This would mislead to the identification of the determinants of CFP. The aim of this section is to identify some of the possible determinants of CFP in Ethiopian manufacturing firms. The dynamic panel data estimation, using a system of GMM, has been a selected approach. It has been hypothesized that, among others, insufficiency of finance (working capital) would significantly affect the productivity of firms. Results from the analysis show that all factor intensities, labour taking the lead and energy the tail, have negative and significant influence on combined factor productivity at 1% level of significance except energy at 5% in both KLEM and KL models. Shortage of foreign currency and working capital both as proxy of financial insufficiency, wielded significant effect on productivity in KLEM and KL models respectively at 10% level of significance. Export and training in their dummies have also shown positive and significant influence on combined factor productivity.This suggested that labour quantification results in loss of combined factor productivity gain unless accompanied by quality enhancement instruments such as training.
Keywords: CFP, Determinants, Factor intensity, partial productivity

1. Introduction

The purpose of factor productivity analysis is not only to measure the level of performance, but also to characterize and analyze the causes of observed performance. This is true both for studies which seek to understand the causes of productivity variations among firms, organizations and other single agents, and for studies which aim at finding the drivers of aggregate productivity growth and (more recently) the determinants of productivity differentials throughout firms and industries. Thus, the measurement of economic performance goes hand in hand with the analysis of the causes of its variations among production units, mainly because an improper measurement of the first is more likely to bring to unreliable results regarding the second. The aim of this section is to capitalize the most

Determinants of combined factor productivity levels and also to provide the main results obtained by empirical studies.(Pieri ,2010).

Knight (1933) as cited in Pieri (2010**)** claimed that if it would be possible to include all outputs and all inputs (in quantities) in the transformation function of the producer, since `nothing can be created nor destroyed', all producers would achieve the same unitary productivity evaluation. However, economists are more interested in the ratio of `useful' outputs to inputs, where usefulness is mainly represented by weights incorporating market prices. This thing raises the problem on how to deal with productivity when not enough outputs or inputs are taken into consideration.

2. Determinants of Combined Factor Productivity: Literature

Various factors were investigated as determinants of productivity differentials among firms. Among others, the following would be mentioned:

Market Concentration

It has considered that market concentration is one of the potential determinants of productivity. Given the diverse complexities that prevail in this type of empirical analysis, further amplified by the different limitations such as data availability and variable construction, we still believe that this approach is valid and could provide some interesting conclusions. (Basu and Fernald, 1997).

Capital Intensities

Industries with higher capital intensities are expected to use resources more efficiently because they cannot afford the rental costs of unused capital and thus, have the incentive to economize the cost of capital to the possible extent. (Mahadevan, 2002). Following this endeavour, the four factor intensities were included as possible determinants of productivity.
(1) Capital intensity, (2) energy intensity, (3) labour intensity, (4) material intensity.

Government regulation

The effect of regulation policy on firm productivity is not easy to be estimated. (Peiri, 2010). Indeed, regulation

affects decisions that firms make at present and also their future market structure, by altering incentives for innovating, investing, entering in the market and the possibility for gaining market shares. Alchian and Kessel (1962) characterized regulated industries as market situations in which firms are either limited in their pursuit of efficiency or threatened by antitrust action, which can be also a limitation for efficiency. Olley and Pakes (1996) have studied successive stages of deregulation in the U.S. Telecommunications Equipment Industry, and they have found that considerable resource reallocation followed deregulation. Deregulation affected productivity of the industry in two different ways: first it changed choices of producers with respect to their innovative activity, the adopted inputs and production volumes, and second it exerted a crowding-out effect on less efficient plants. Pozzana and Zaninotto (1989) study the effect of the market structure on productive efficiency in a sample of firms in the Italian retail industry.

Management roles

Choices of technology, inputs, and production are made by management and, thus, better managers may make better choices. Two lines of research have been developed regarding the role of management and the type of ownership with respect to firms' productivity. The first one deals with the effect of mergers on productivity growth. Lichtenberg (1992) and McGuckin and Nguyen (1995), exploring the issue in a large panel of U.S. manufacturing plants, found that establishments which faced ownership change also enjoyed above-average productivity growth for several years after a change: this could be due to a reduction in corporate overhead and a reduction in auxiliary offices. The second one deals with differences in performance of private and State-owned enterprises. Alchian (1965) backed the inferior efficiency pursued by managers of the public sector enterprises, due to the looser control exerted by owners with respect to owners of private enterprises; Pestieau and Tulkens (1993) analyzed the difference in technical efficiency between private and State-owned enterprises, while Bottasso and Sembenelli (2004) provided an interesting analysis of differences in technical efficiency in a representative sample of Italian manufacturing enterprises, ending no difference in efficiency between private firms and affiliates to national groups, while State-owned enterprises show the lowest levels of efficiency.

Technology

Technology provides important sources of productivity differentials among firms. Nelson (1981) as cited in Pieri(2010) emphasized the importance of understanding the way in which technology is generated and distributed through firms, and many empirical studies have documented the correlation between some measure of technology and productivity at the micro level (Dunne, 1994; Lichtenberg, 1996, among others), unfortunately suffering of a possible `reverse causality' explanation which goes from productivity to the adoption of more advanced technologies in the organization of the firm.(Pieri,2010).

Interestingly enough technology has been found to be strictly related to labour quality in the study by Doms, Dunne, and Troske (1997), in which the presence of workers with skills above of the average was found to be related to the adoption of advanced technology.

Firms' export status

Various literatures on the relationship between firm productivity and the export status have increased over time. Since the early works by Bernard and Jensen (1995,1999) on U.S. exporters, and by Roberts and Tybout (1997) and Clerides, Lach, and Tybout (1998) on a sample of developing economies, an open debate started on the direction of the relationship found between the exporting activity and firm productivity. The hypothesis of self-selection claims for an auto-selection operated by more productive firms to the export activity: these firms can exploit their comparative advantage thus being more suited to overcome obstacles related to the exporting activity; on the other hand, firms engaged in export activities could learn new technologies in the host country, thus improving their efficiency (through learning effect). While the former hypothesis has found a robust support in empirical works, the latter has generated contradictory results.

However, a group of studies using econometric techniques able to control for the `endogenous' exporting choice have supported the evidence of a learning effect: Aw, Chung, and Roberts (2000) provided evidence for Korea and Van Biesebroeck (2003) did the same for Sub-Saharan manufacturing plants. Castellani (2002) and Serti and Tomasi (2008) have provided econometric evidence supporting the hypothesis that export behaviour cause learning effects in different representative samples of Italian manufacturing _rms. Another strand of the literature has pointed out that firms engaging in foreign direct investments show higher level of productivity than domestic firms and simple exporters, first because they need to overcome the cost of doing business abroad (Helpman, Melitz, and Yeaple, 2004), but also because investing abroad they may be able to access foreign knowledge and reaping the benefit of higher economies of scale (Cantwell, 1995; Fosfuri and Motta, 1999).

Organizational structure

As Syverson (2010) has underlined, the organizational structure of the firm can be related to its productivity level. In particular the control over vertical links of production seems a strategic choice which brings to different performances: more integrated structure can have a better control over the production chain, both allowing for an easier movement of physical and intermediates inputs along the chain and for a sharing of human capital and management skills among different phases and activities; however, disintegrated structure |which have become more and more common in the world in recent years may focus on their core competences, leaving unproductive phases to the `outside' and reaching an higher flexibility.

Firm size

The size of the firm as a measure of economies of scale has often been found to have an effect on combined factor productivity. With economies of scale, firms would be able to take advantages of the relative savings of inputs. It has been suggested that larger firms have higher efficiency due to economies of scale with respect to technical knowledge resulting from their past efficiency.

Training

Trainings provided to the workers are expected to raise technical efficiency. Such workers contribute effectively to the acquisition and combination of productive resources and they are more receptive to new reforms of production and management. (Mahadevan, 2002).

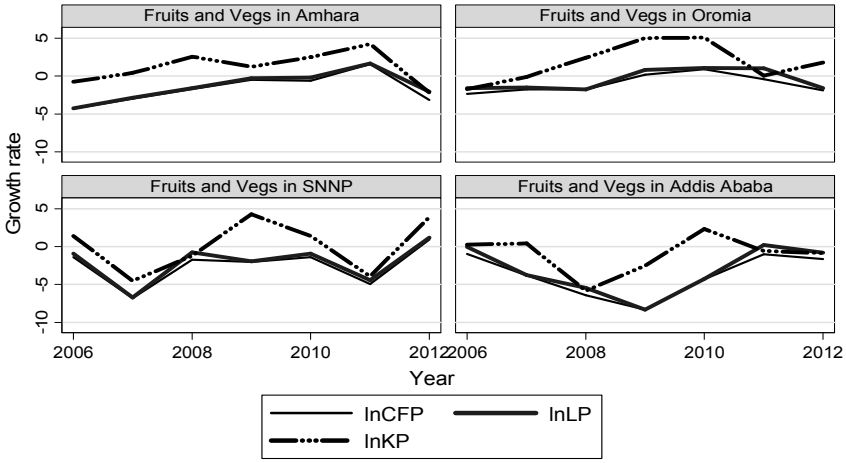
In this part of the study, we continue to hypothesise that factor intensities (measured in terms of the ratios of each factor to output), shortage of foreign exchange (as a proxy for the measure of intervention of the government), and shortage of domestic demand, training, export and bonus besides the shortage of electricity and water are the major factors that drive CFP in the a developing country like Ethiopia. The study utilized the application of recent panel econometric methods to test panel unit roots, specifically, Im et al.'s (IPS) (1997) panel unit root tests, and the application of a recently developed bounds testing procedure on panel data. In this study, we used panel methods to test a CFP equation in levels instead of a typical economic growth model.

3. Partial productivity and combined factor productivity of firms: by region

Among the common measures of productivity, partial productivity measure in terms of labour and capital productivity would be mentioned. Partial productivity is the ratio of gross output to the respective primary inputs. The partial productivity measure, as it ignores all the other inputs except the one in question, couldn't measure holistic variation in productivity. Regional disparity of firm productivity has been examined in this section for similar firms in each category. The disparity began from the skewness in the physical distribution of industrial firms across regions.(Amare 2015). Despite this, perhaps due to lack of concrete empirical studies, nobody has brought it to the forefront for manifestation. The following figures illustrated the trend of partial productivity (capital and labour mainly) and combined factor productivity along time (2006–2012) and across regions. Labour productivity and combined factor productivities moves in the same direction at almost equal rate of growth in all regions. This implies the existence of strong positive correlation between one another. Capital productivity has shown far greater potency of variation and extent over the years than labour and CFP.

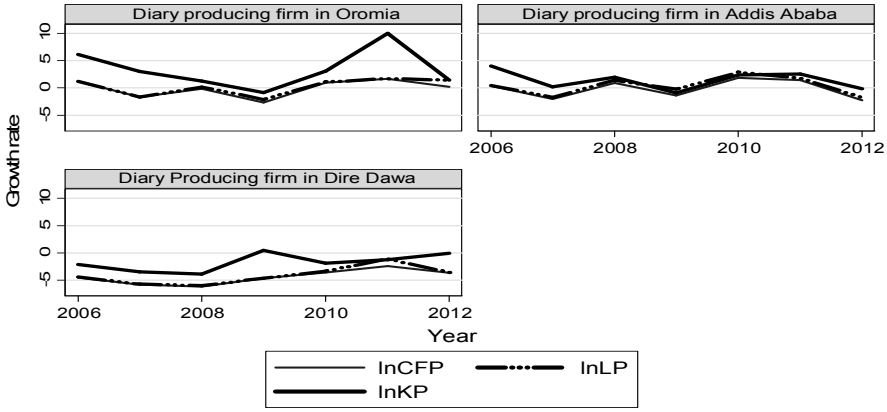
Trends of growth rates for partial productivities and combined factor productivities of some selected firms across regions are illustrated in the following figures. Except for tanning of leather firms in Tigray and Amhara(fig:-16) where capital productivity growth has a diverging movement from labour and combined factor productivity, all the three have same direction of movement albeit the fact that capital shows faster rate.

Fig 1:Capital ,Labour and Combined Factor Groductivity growth rates of Fruits and Veg by Regs



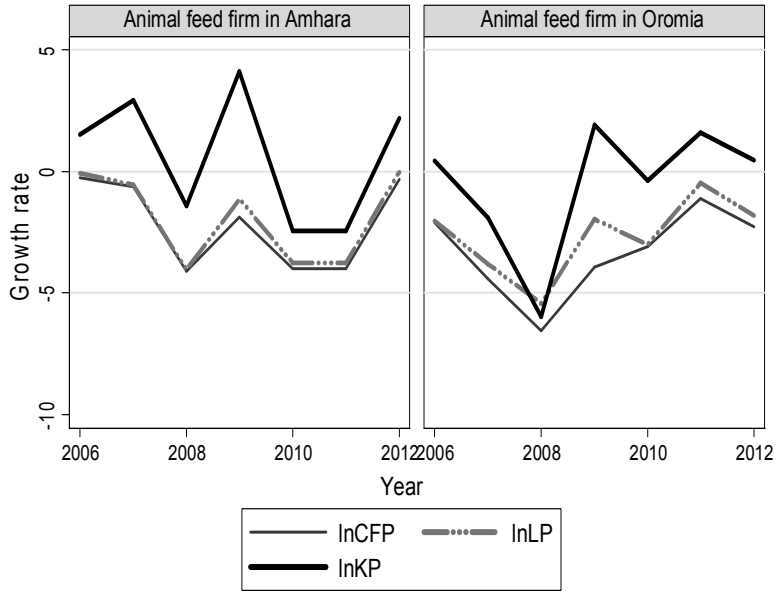
Graphs log of partial and combined productivities by Regs

Fig3:Factor and combined factor productivity growth rates of diary firms by Regs



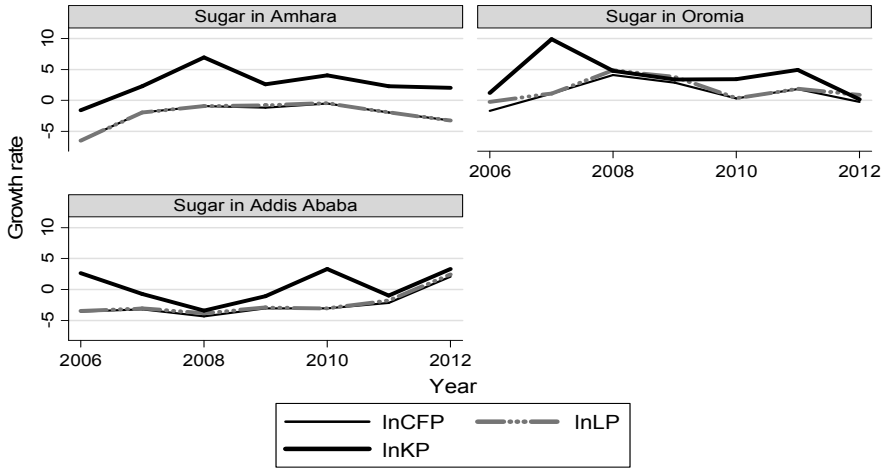
Graphs Factor and combined factor productivity growth rates of diary firms by Regs

Fig5: Factor and combined factor productivity growth rates of Animal feed firms by Regs



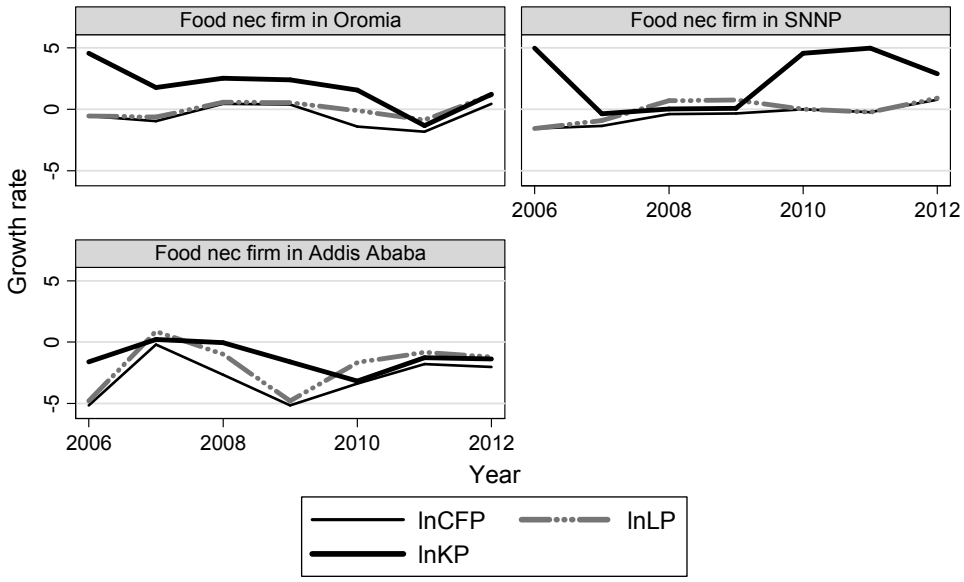
Graphs Factor and combined factor productivity growth rates of Animal feed firms by Regs

Fig7: Factor and combined factor productivity growth rates of sugar firm by Regs



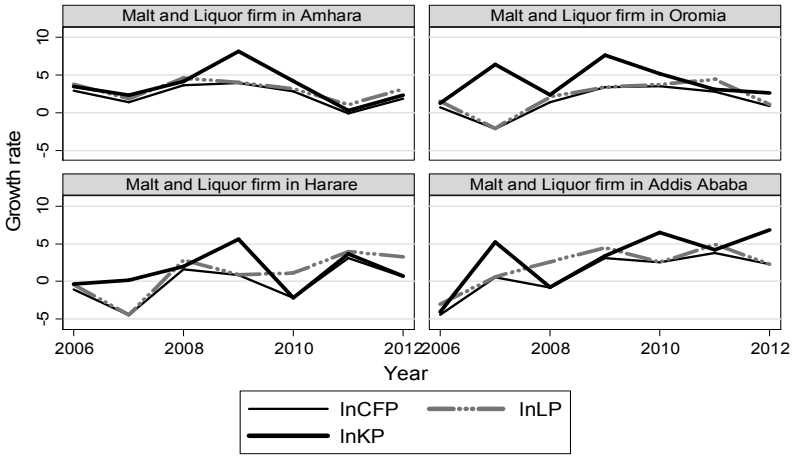
Graphs Factor and combined factor productivity growth rates of sugar firm by Regs

Fig9: Factor and combined factor productivity growth rates of food nec firms by Regs



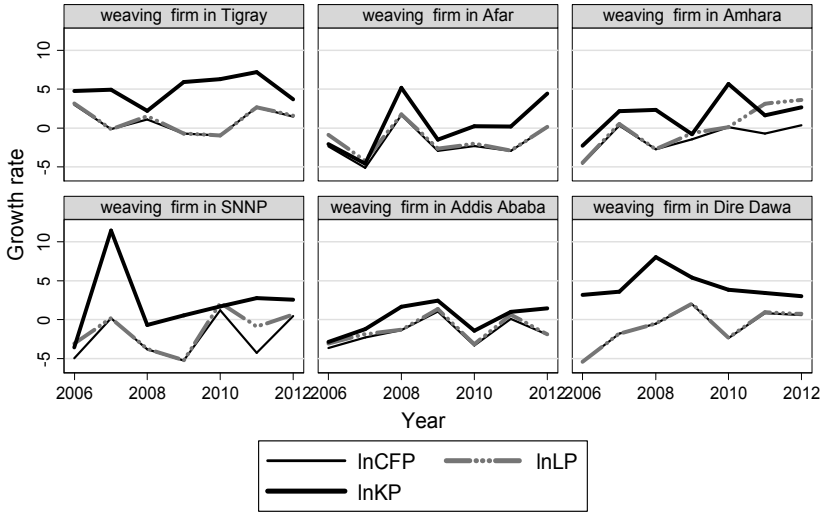
Graphs Factor and combined factor productivity growth rates of food nec firms by Regs

Fig11: Factro and combined factor productivity growth rates of Malt firms by Regs



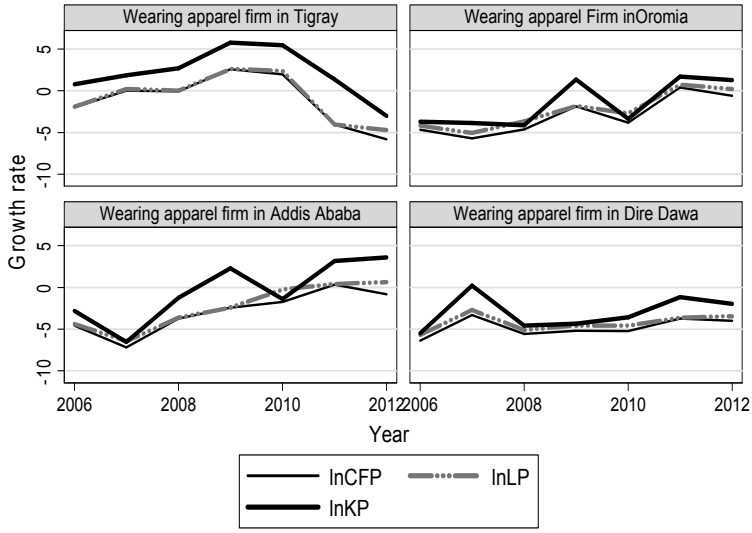
Graphs Factro and combined factor productivity growth rates of Malt firms by Regs

Fig13: Factor and combined factor productivity growth rates of Weaving Firms by Regs



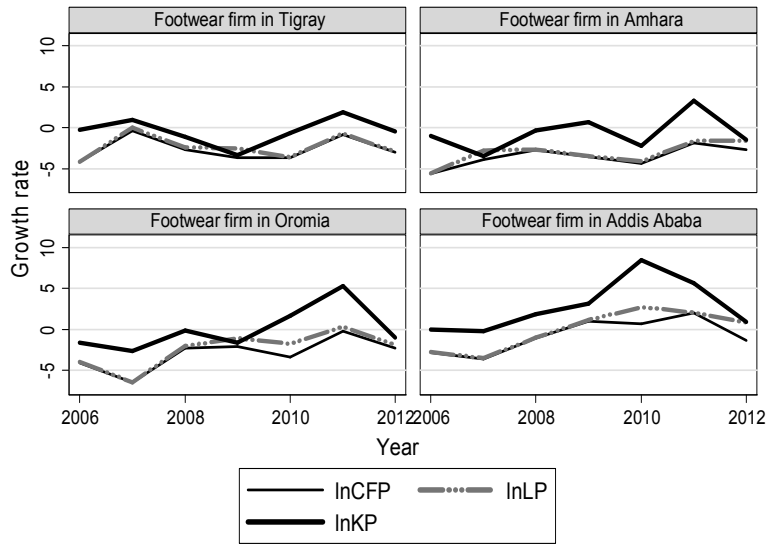
Graphs Factor and combined productivity growth rates of Weaving Firms by Regs

Fig15: Factor and combined factor productivity growth rates of apparel firms by Regs



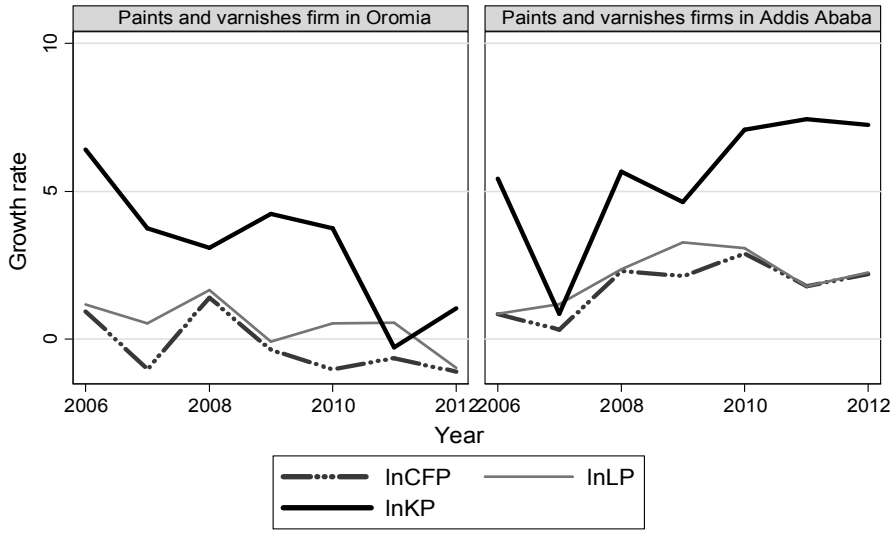
Graphs Factor and combined factor productivity growth rates of apparel firms by Regs

Fig17: Factor and Combined factor productivity growth rates of footwear firms by Regs



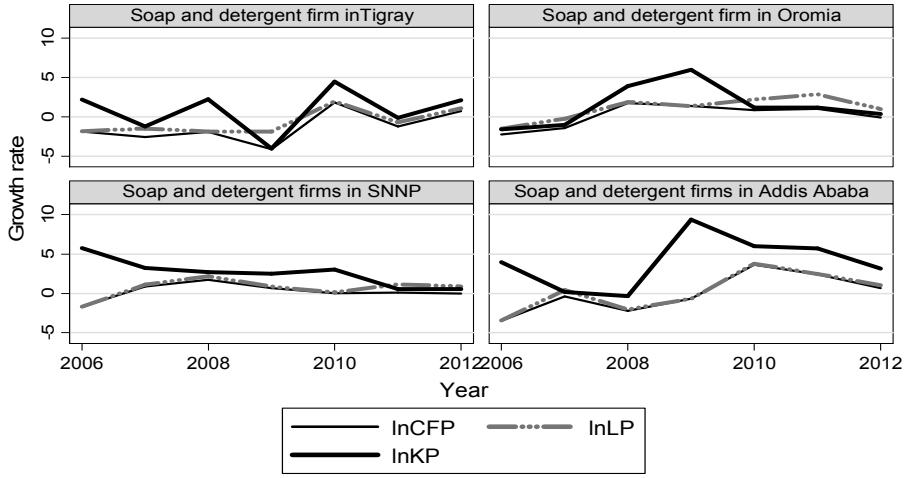
Graphs Factor and Combined factor productivity growth rates of footwear firms by Regs

Fig19: Factor and combined factor productivity growth rates of paints firms by Regs



Graphs Factor and combined factor productivity growth rates of paints firms by Regs

Fig21: Factor and combined factor productivity growth rates of detergent firms by Regs



Graphs Factor and combined factor productivity growth rates of detergent firms by Regs

4. Estimation Analysis

In this section, we consider the average level for CFP and TFP as dependent variables. The explanatory variables include factor intensities (KI, LI, EI and MI)for the year 2006 -2012,dummyTraining-1 if the firm offers training (yes) 0 otherwise , dummyBonus-1 if the firm provides bonus (yes) 0 otherwise , dummyexport-1 if the firm exports in the study period 0 otherwise, dummyYear, size as medium and large, shortage of demand(shdd), shortage of foreign exchange (shforex), shortage of electricity and water (shelecwa)shortage of raw material (shrmt),government rules and regulations (grr). Moreover, since we are analysing level of CFP and given the characteristics of the panel dataset is such that N large and T small, dynamic panel data estimation, using a system of GMM, is a natural candidate to be considered. This type of estimation is able to account for unobserved individual specific effects and allows for the endogeneity of one or more of the regressors. In particular, the specification takes the following structure:

$$lnCFP_{it} = \beta + \varphi X_{it} + u_{it}, \quad \& \quad lnTFP_{it} = \beta + \varphi X_{it} + u_{it} \text{.....(6.1)}$$

Where $lnCFP_{it}$ is the logarithm of CFP_{it} and X_{it} is a vector of explanatory variables which would be extended as follows:

$$lnTFP_{it} = \varphi_2 lnKI_{it} + \varphi_3 lnLI_{it} + lnexper_{it} + size_{it} + shrmt_{it} + shspr_{it} + shforex_{it} + shdd_{it} + shwk_{it} + grr_{it} + dummyBonus_{it} + dummyexport_{it} + dummyYear_t + dummyTraining + u_{it} \text{.....(6.2)}$$

$$lnCFP_{it} = \varphi_2 lnKI_{it} + \varphi_3 lnLI_{it} + \varphi_4 lnEI_{it} + \varphi_5 lnMI_{it} + lnexper_{it} + size_{it} + shrmt_{it} + shspr_{it} + shforex_{it} + shdd_{it} + shwk_{it} + grr_{it} + dummyBonus_{it} + dummyexport_{it} + dummyYear_t + dummyTraining + u_{it} \quad \text{.....(6.3)}$$

$\varphi_{i's}$ are parameters and KI –capital intensity, LI-labour intensity,EI-energy intensity, MI- material intensity, exper-production experience of firms, size of firms as either medium or large, shrmt-shortage of raw materials, shspr-shortage of spare parts, shforex-shortage of foreign exchange, domdd-domestic demand, shwk-shortage of working capital, grr-government rules and regulations, and the others are bonus, export, training and time dummies coupled with the error term.

Hsiao (1986) demonstrated that, omitting unobserved time invariant individual effects in a dynamic panel data model would cause OLS levels estimates to be biased and inconsistent. Nickell (1981) on the other hand, argued that the within estimator would also provide biased and inconsistent estimates in a dynamic panel model with fixed time var. In addition, one or more regressors could be correlated with the error term. To solve these issues and the potential persistence of the series, commented earlier, Blundell and Bond (1998) argued that a system GMM is the most appropriate method. Arellano and Bond (1991), Arellano and Bover (1995) all the essentials have extensively explained the GMM estimation method.

5. Estimation Results

Dynamic panel data regressions (N = 75 firms, T = 7 years) are estimated. We considered the logarithms of levels of CFP and TFP as dependent variables. The explanatory variables are as specified above. Based on the elucidated advantages of the system of GMM estimator, table 6.1 shows the findings. It appeared on the table that all factor intensities have negative and statistically significant effect at 1% and at 5% (for energy) level of significance on both CFP and TFP of KLEM and KL model. Shortage of raw materials, shortages of foreign exchange and working capital have also similar effects though significant only at 10% level of significance for the later two in KLEM and KL models respectively. This is an indication on financial constraints which the firms are encountering for the expansion and quantification of their output. On the other hand, there is a positive and statistically significant relationship between export, training, bonus and productivity. An exporting firm has 0.264 and 0.123 more productivity than a non exporting firm in KLEM and KL models respectively.

$$lnCFP = -.134\, lnKI - .749 lnLI - .021 lnEI - .085 lnMI + .697 lnexper - .011 sizelarge - .022 shrmt + .163 shspr - .145 shforex + .046 domdd - .076 shwk + .641 grr + .749 dummyBonus + .264 dummyexport + (-.010, -.118, -.224, -.169, -.309, -.149) dummyYear_{2-7} + .047 \text{dummyTraining} - 3.24 \quad \text{..... (6.4)}$$

$$lnTFP = -.189 lnK \; \text{I} \; -.847 lnLI + .443 lnexper - .036 sizemedium - .013 shrmt + .473 shspr + .061 shforex + .439 shwk + .171 shdd + .023 grr - .001 dummyBonus + .123 dummyexport + (.030, -.075, -.104, -.150, -.131, -.230) dummyYear_{2-7} + .191 dummyTraining - 2.202 \text{ .----------(6.5)}$$

Table 1: Estimation Results for KLEM and KL of the years 2006-2012

Arellano-Bond dynamic panel-data estimation

Prob > chi2 = 0.0000

One-step results	lnCFP		lnTFP	
Variables	Coef.	Std. Err.	Coef.	Std. Err.
lnCFP	1[1] KLEM	2	3 KL	4
L1.	-.0048732	.0175611	-.0187736	.0303829
lnKI	-.1348557*	.0127509	-.1896815*	.0209701
lnLhI	-.7493217*	.0241998	-.8474773*	.0377397
lnEI	-.0212391**	.0102827		
lnMI	-.0859541*	.0104273		
lnExper	.6976638	.6098648	.4431543	1.1413230
large	.0312528	.0754121	-.0366912[2]	.1172259
shrmt	-.022659	.0727571	-.0139004	.1177511
shspr	.1630909	.239218	.4735105	.352439
shforex	-.1455521***	.0886835	.0614966	.1432466
domdd	.0465837	.0880936	.1716524	.1349256
Shwk	-.0766947	.1506999	.4399349***	.237955
grr	.641463**	1.819763	.0231706	.1830451
dummyBonus1	.749076	.3654889	.0014279	.8175982
dummyVexport1	.264146**	.819763	.1231706**	.1730325
dummyYear2	-.010313	.136309	.030313	.136309
dummyYear3	-.1186204	.0863394	-.0754734	.1453673
dummyYear4	-.2242124**	.1093259	-.1048637	.1807989
dummyYear5	-.1696996	.1396956	-.1506583	.2333948
dummyYear6	-.3099641***	.1679089	-.1311156	.2779506
dummyYear7	-.1494945	.2041981	-.2305231	.3358639
dummyTraining1	.0473837***	.0680936	.1916525***	.1249342
_cons	-3.2484770***	1.715036	-2.2025720	3.312504

Instruments for differenced equation
GMM-type: L(2/.).lnCFP L(2/.).lnTFP
Standard: D.lnKI D.lnLhI (D.lnEI D.lnMI) lnExper medium shrmt shspr shforex shdd shwk
dummyBonus2 dummyYear2 dummyYear3 dummyYear4 dummyYear5 dummyYear6 dummyYear7
Instruments for level equation

Training has also similar assenting effect on productivity and hence, industrialists ought not to compromise the quality of labour through provision of relevant and appropriate training for their workers. Production experience, size, domestic demand, regular machine breakage and shortage of spare parts have positive but statistically insignificant effect on CFP and TFP in both models. The positive causation of regular machine breakage and shortage of spare parts on productivity has no sense. This implies that factor accumulation particularly labour factor is no longer to enhance CFP and TFP as 0.75 and 0.85 of change in CFP and TFP would be resulted per unit of labour intensity variation followed by capital intensity which resulted 0.13 and 0.18 variation in CFP and TFP per unit change in capital intensity.

Thus, there are implications that physical capital accumulation might no longer be a relevant productivity enhancing factor. Here, it is important to highlight the role of export and its contribution to productivity improvement in both models. Training has also similar positive and statistically significant impact on productivity. Bigsten and Gebreeyesus (2009) showed that exporting firms in Ethiopia are generally more productive than non-exporters and increase their productivity faster. While part of this is explained by self-selection, the authors also found strong evidence of "learning-by-exporting". It can be assumed that experiences of exporters exposed to sophisticated international markets which create a number of knowledge spillovers for the local economy.

6. Conclusion

The section has been devoted on the examination of productivity determinants based on theoretical underpinnings and firm real experiences. Variables which firms reported as their primary, secondary and tertiary problems in their production experience have been taken as determining factors of combined factor productivity thereby to estimate the potency of influence of each variable.

Regardless of the model types, factor intensification resulted in loss of combined factor productivity

[1] Columns 1&2 refers to the coefficients and standard errors of KLEM (CFP) while columns 3 &4 to KL(TFP).
[2] Size medium
*, ** & *** refers significant at 1%,5% and 10% level of significance respectively.

with labour intensity taking the lead. The implication of this is that for the activity unit to scale up its productivity, prompting labour quality via trainings would be indispensible than quantifying any of the inputs. Firms' productivity would also be affected adversely by the financial constraints which the existing financial institutions are not able to address. This finding is consistent with the real situation prevailed in the country where only 26%-46% of investors financial demand has been satisfied. The figure would be much less than this as the number of entrant firms increased due to the call for of the GTP. Hence, on account of this, it would be far more important to set up distinguished industrial financial corporations and industrial banks excluded for the manufacturing firms long-term finance source. It then, the main challenges of financial shortage in industrialization of a developing country like Ethiopia would be resolved. Export and training of firms bear awakening effect on combined factor productivity. "Learning from exporting" really created a line of variation among those which exports and not exporting firms. The exporting firms earn 26% more productivity benefits than the non-exporting counterparts in KLEM and 18.6% more in KL. In KL model, training has more productivity augmenting effect (19%) than in KLEM (4%). Government rules and regulations, centralized industry related training and industrial finance would be the proxies for the industrial policy where each of them has significant power of influence on combined factor productivity. Thus, incorporating such elements in the industrial policy would have paramount implication at least in the next GTP.

Firm size and production experience though positively influence productivity of firms, it is not statistically significant. But the economic theories in this regard assert that firm size determines scale of economies of the production unit which in turn, has effect on productivity. It is fortunate for Ethiopian manufacturing firms that shortage of effective demand and raw materials would not be able to determine productivity performance that much.

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