Firm Dynamics and Productivity Growth in Indian Manufacturing: Evidence from Plant Level Panel Dataset*

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Abstract

This paper examines the effects of firms' dynamics on industry level productivity growth in India during the period 2000-01 to 2005-06 using plant level panel data of 22 manufacturing industries. The empirical analysis is based on decomposition techniques of aggregate productivity growth. The analysis is confined to large sector plants. Results suggest that the contribution of entry of new plants to aggregate productivity growth is positive in most industries. While newly established plants have rather small entry effect, small plants that grow and enter the large size class have substantial effects on industry level productivity growth. In low tech matured industries entry effects are supported by the productivity growth of the continuing firms. In medium tech industries entry effects are modest; productivity growth of the continuing firms is supported by reallocation effects. In high tech industries all the three effects seem to reinforce productivity growth.

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1. Introduction

Recently there has been a surge in the literature on industry dynamics allowing for firm heterogeneities and/or idiosyncratic shocks. Though the origin of this literature can be traced back to Schumpeter (1934, 1942) where he proposed the process of 'creative destruction' to explain the dynamics of industry evolution, recent developments in this literature are inspired by the theory of firm selection and industry evolution proposed in the seminal works of Jovanovic (1982), Hopenhayn (1992), and Ericson and Pakes (1995). What is new in the emerging literature is that empirical findings have been developed in parallel with emerging theoretical literature due to the growing availability of longitudinal plant-level data that permits the analysis of industry dynamics (Foster et al 2001). One strand of this emerging literature emphasises the potential role of entry and exit in heterogeneity across plants and seeks to explore the impact of such micro heterogeneity on aggregate productivity growth. Following the pioneer works of Baily et al (1992) and Griliches and Regev (1995), this literature examines the contribution of new and exiting firms by decomposing exercises of aggregate productivity growth (*inter alia*, Baldwin and Gu 2006, Cantner and Krüger 2008, Carreira and Teixeira 2009, Disney et al. 2003, and Foster et al. 2001). The common premise across these studies is that productivity growth is not only due to internal restructuring within established firms, but also to productivity of entry and exit of firms. The present study is embedded in this literature. Its objective is to examine the effects of firms' dynamics on industry level productivity growth in the Indian context, using the hitherto unexplored plant level data on Indian manufacturing for the period 2000-01 to 2005-06. In particular, we focus on productivity differences between continuing, entering and exiting firms. Our hypothesis is that firms' entry and exit generate *positive and significant* productivity effects at the industry level. The empirical analysis is based on the decomposition methodology of aggregate productivity growth pioneered by

Baily et al (1992) and subsequently developed by important contributions of several scholars (Griliches and Regev 1995, Foster et al 2001, Balwin and Gu 2003, Olley Pakes 1996, and Melitz and Polanec 2009). It uses three different methodologies for the analysis: Foster et al (2001), Griliches and Regev (1995) and Melitz and Polanec (2009). Given the data constraints, the analysis focuses on the large corporate sector; small sector is out of the purview of the study. This provides us an opportunity to make a distinction between two forms of entry: one, direct entry of newly established plants, and two, entry of existing small sector plants in the relatively larger factory sector by way of expansion. The analysis thus makes an important contribution to the existing empirical literature by distinguishing between the productivity effects of two types of entrants: newly established plants and the existing survivors that have been learning about investment and innovation opportunities passively (Javonvic 1982) or actively (Pakes and Ericson 1989) and expanding to enter the large corporate sector. There is a plethora of studies on productivity growth in Indian manufacturing (e.g. Ahluwalia 1991) but to the best of our knowledge, this is the first study on the effects of firms' dynamics on productivity dynamics.

India makes a good case study for the productivity effects of entry and exit as it is an emerging economy that has substantially relaxed policy-erected barriers to business and trade over the past two decades. Indian initiated the process of economic reforms rather cautiously in the mid 1980s. In 1991, however the pace of reforms was accelerated and the country drifted away from an import substituting regime towards export oriented strategy for growth. Since then comprehensive reforms have been introduced in industry, trade, financial and fiscal sectors to improve efficiency, productivity and international competitiveness of the industry and to impart dynamism to the overall growth process. Evidence suggests that economic reforms have had a significant impact on business dynamics in the industrial sector (Mody et al 2010, Aghion et al. 2005). This provides a perfect setting for the analysis.

The rest of the study is organised into 8 sections. Section 2 provides an overview of the economic reforms introduced in India and their effects on firms’ entry and exit. Section 3 describes a theoretical framework relating to firm turnover and productivity levels. Section 4 provides an overview of decomposition methodologies. Section 5 presents a brief review of the background literature. Section 6 focuses describes the modeling and the data. Section 7 describes plant dynamics using the data. Section 8 evaluates the entry and exit effects on productivity growth. Section 9 offers some concluding remarks.

2. Economic reforms and business dynamics in India: An overview

After independence, India embarked on a strategy of state-led industrialization based on import substitution. An elaborate set of controls were devised to direct the process of industrialization to suit the path of development envisaged in the various 5-year Plans. The key policy instrument of industrial controls was the industrial licensing policy, 1951 which regulated entry, exit and expansion of industrial units rather tightly. Private sector participation was excluded from a number of sectors by reserving them only for the public sector companies. Manoeuvrability of private firms was regulated even in those sectors where their entry was allowed. They needed a license to open a new factory, change location, produce a new product or expand capacity by more than a specified margin. Such licenses were given in accordance with the macro-economic plan targets. Over the years, the government added more tools to this basic instrument of industrial policy, further tightening the entry and movement of industrial units. For example, in 1969, the MRTP act came into force under which all applications for a license from companies belonging to a list of big business houses and subsidiaries of foreign companies were to be referred to a ‘MRTP Commission’ which invited objections and held public hearings before granting a license for production. Further, a 1973 resolution reserved certain sectors for small scale producers. The number of sectors was subsequently expanded during the 1970s. In 1973, the FERA act was enforced, which restricted the entry of foreign companies only to high-tech core sectors and required them to reduce their share in equity capital to below 40% in other sectors. These policy initiatives were complemented by restrictions on foreign technology imports, and high tariff and non-tariff barriers on imports stifling all efforts to start new businesses and /or expand the existing ones by both, foreign and domestic entrepreneurs.

While entry was tightly regulated, exit was discouraged at any cost. Closure of an industrial unit was considered to be a social loss due to loss of employment and, hence, this outcome was avoided wherever possible. In order to facilitate operation of the sick industrial units, government owned banks and financial institutions were directed to provide them credit at subsidized interest rates. In 1971, through an amendment in the Licensing Act, the central government was empowered to take over industrial undertaking with special emphasis to sick units. In 1977, a merger policy was announced which offered fiscal incentives to healthy industrial units to merge sick units with them. Several concessions were also announced by the RBI from time to time to encourage banks to bail these units out.

The first tentative moves towards deregulation were made during the early 1980s, but the pace of deregulation accelerated with the unveiling of the “new economic policies” in 1985. A series of piecemeal reforms were introduced with the objective of improving productivity in existing units. Under certain conditions, business houses were allowed to operate outside their permitted list of sectors. They were allowed to expand in related areas without seeking fresh licence under the facility of broad banding. Some sectors were delicensed. Existing companies could set up new production units, without restriction on size, provided the latter were 100 per cent export oriented. Access to foreign technology, hitherto severely restricted, was relaxed across the board and duties on project related imports were reduced along with those on all other capital goods. The upper limit of investment in the small scale sector was also revised to allow them to expand. Notably, all these reforms were favourable to existing companies; they did not facilitate the entry of new firms. Further, status quo was maintained with respect to the licensing procedure which was heavily loaded in favour of incumbents (Bhagwati, 1982, 1988). Meanwhile, the exit policy was further tightened. In 1981 the government announced a new strategy under which large sick units employing more than 1000 employees and having investment worth Rs 90 million or more could be nationalized. In 1982, the state governments were empowered under the 'Relief Undertaking Act' to declare sick units owned by them or those that borrowed from them or state financial institutions, as relief units. All dues and payables of these units were frozen. In 1985, the Companies (Special Provisions) Act, or SICA was promulgated. To enforce the Act, the Board for Industrial and Financial Reconstruction (BIFR) was set up in 1987. Under the SICA, any company that has been registered for more than 7 years and whose worth has been completely eroded must apply to BIFR for permission for closure. Filing with BIFR automatically suspends all legal proceedings and creditors can not attach and liquidate assets of the defaulting companies. While the BIFR has been given powers to approve winding up of a unit, the process is very time consuming. Furthermore, winding up of companies is not under its jurisdiction. It is the jurisdiction of the high court. Thus the winding up can take upto a decade after reference has been made to BIFR under SICA. In general, sick units are encouraged to merge with healthy units. Since the managers of sick companies do not face any cost of bankruptcy, there are strong incentives to overlook impending financial distress (Gangopadhyay and Knopf, 1998). As of December 31, 1980 the number of sick units was 24,550 with Rs. 18086.6 million locked in them; by December 1990, it increased to 212,097 and Rs. 93,830 million, respectively. The Act thus facilitated the creation of non-performing assets on the balance sheets of the banks (Bhaumik and Mukherjee, 2002) and skewed the playing field against potential entrants. In the process, capital was tied up in loss-making industrial units instead of being delivered to new units of production.

The process of reforms was accelerated in 1991 and marked a departure from the earlier development strategy. These reforms laid a strong emphasis on enabling markets and globalization. Licensing was abolished for all industries except those that were related to defence or were potentially environment-damaging. The number of industries reserved for the public sector was cut down from 17 to 3. Both FERA and MRTP acts were repealed. By the end of the 1990s, most manufacturing units were allowed 100 per cent FDI under automatic approval. Procedures for the procurement of technology from abroad were also simplified. Until the end of the eighties, prices of most infrastructure and basic intermediates were controlled by the government on a cost-plus basis, under the aegis of the administered price regime (APR). In the nineties, the APR was also abandoned. Further, trade barriers were considerably relaxed and non tariff barriers were completely removed, intensifying import competition in the economy (Das, 2003).

While entry barriers are considerably relaxed, exit policy is still tightly regulated. Since 1991, government companies have also been under the purview of SICA. To expedite the clearance of cases some reforms were introduced in the internal functioning of BIFR in the early 1990s. By 1996, the average time in the first hearing reduced to 30 days against 160 days in first five years and the number of hearings increased to 1560 against 61 in 1988. But the long delays in the final judgment (including high court rulings) continue to favour sick units. In view of high levels of non performing assets, the 'Securitisation and Reconstruction of Financial Assets and enforcement of Security Interest Act' (SARFESI) was introduced in 2002. Under the Act, sweeping powers have been granted to secured creditors for the recovery of the dues. They can simply seize the assets of the company and sell them to the highest bidder, irrespective of the fact that the case is registered with SICA. It is no longer necessary for them to take any legal course. In the same year, the 'Companies Act (second amendment) Act' was passed. In the Act, the Board for Industrial and Financial Reconstruction (BIFR) and Appellate Authority for Industrial and Financial Reconstruction (AAIFR) are proposed to be dissolved, and replaced by National Company Law Tribunals (NCLT) and National Law Appellate Tribunal (NCLAT) respectively. It proposes to give the NCLT the jurisdiction and power relating to winding up of companies presently vested in the High Court. However, the act could not be enforced till date. Notably, the SARFESI Act, 2002 has also been facing legal wrangles. A 'New Companies Bill' is in the Parliament for consideration. This has a provision for a viable, time-bound exit policy. Meanwhile, SICA continues to be in operation and the problem of industrial sickness continues to exist with 89,641 sick/weak units reported by the RBI in 2008.

Drawing on the above discussion, we believe that economic liberalization of the early 1990s is associated with significant entry even while exit rate is still very low. Existing studies agree that economic liberalization has facilitated business dynamism in terms of the number of entry, and growth in assets, sales and profits. Opinion however seems to be divided on the impact of this dynamism. One view is that liberalization fostered business dynamism through removal of entry barriers (Mody et al 2010, Panagariya 2008, Aghion et al. 2005, Bhaumik et al. 2009, Bhuamik et al. 2008) and hence is pro-market. The other view considers reforms as pro-business and argues that the new dynamics are generating incentives to accumulate excessive market power for economic entrenchment by the large incumbent firms such as state firms and business houses (Alfaro and Chari 2009, Bertrand et al. 2002, Rodrik and Subramanian 2004, and Kohli 2006). The underlying argument is that the entry of firms has not been accompanied by the exit of business houses and government owned firms. As a result, the Indian business sector continues to be dominated by government-owned firms and conglomerates with influence over market conditions (and government policies and regulation). Alfaro and Chari (2009) steers the Indian economy clear off the Schumpeter's creative destruction paradigm on the basis of the argument that the entrants did not replace the incumbents who should exit after the new entry. In contrast, advancing the pro-market view, Mody et al. (2010) claim that there is no robust, and consistent relationship between increases in firm-level profitability and market shares, which, according to them, is more a sign of dynamism than entrenchment. They also argue that business houses can also be a source of dynamism though there is no evidence in their paper to support that.

This debate completely overlooks the 'productivity dynamics' which form the core of business dynamism. The creative destruction paradigm is characterised by the creation of novelty and the destruction of old products and processes and not necessarily old firms. The existing firms perish in the evolutionary process if they do not upgrade their competencies. Even while they are not allowed to wind up their operations they stop functioning or downsize them. The process of creative destruction is thus a concept that reflects competition for productivity gains. To the best of our knowledge however there is no study that has analysed productivity dynamics that arise from entry and exit and their role in enhancing aggregate productivity growth in the Indian context. Entering firms add to productivity if they are more productive than the existing firms. Further, increased competition from the entry threat may stimulate the productivity growth of established firms as well (Aghion et al. 2009 and Falck et al. 2009). Thus, incumbents in industries with a high entry rate have an increasing pressure to improve their performance. We thus argue that business dynamisms are pro market if the process of creative destruction enhances the macro-level productivity.

3. Firms' dynamics and productivity growth: A Theoretical framework

According to Schumpeter (1934, 1942), innovative entry by entrepreneurs is the force that drives industry's evolution and sustains economic growth, even as it destroys the value of established companies that have enjoyed some degree of monopoly power derived from previous technological, organizational, regulatory, and economic paradigms. The implication is that the productivity growth of an industry is enhanced by the entry of new firms. In his seminal work, Jovanovic (1982) departs from this line of thinking and suggests an alternative approach. He postulates that heterogeneous firms enter the industry without knowing what their true productivity is. Once they enter the market, they learn about the distribution of their own profitability, based on noisy information from realized profits. By continually updating such learning, the firm decides to expand, contract, or to exit. Hopenhayn (1992) developed a model to capture these market dynamics in long rum equilibrium of an industry composed of a large number of price-taking firms producing a homogeneous output. His model predicts that surviving members of the entering firms have a higher productivity than those members that exit. Thus only high productivity entering firms remain in the industry whereas the less productive ones exit. Another important prediction of the model is that the productivity of any member of continuing firms at time t is greater than that of the member of entering firms. This is because as the continuing firms age, more selection takes place and surviving members concentrate a higher proportion of high productivity units. In both these models, establishments are basically passive, acting in response to market signals. Pakes and Ericson (1989) investigate how outcomes from a Jovanovic-style model of 'passive learning' would differ from results generated by a model allowing for ‘active exploration’ of investment/innovation opportunities. They find that both types of models generate similar results. Success is not guaranteed by investment in active learning. They conclude that new firms are either passive learners or active explorers. If they survive they grow and enter in larger classes. One of the main theoretical implications of these models is that new entrants will, on an average, have lower productivity and a higher probability of exit than the incumbents. They survive if their productivity is higher than those who exit and if they survive their productivity grows further through the selection process. The entry effects are therefore likely to be small.

Melitz (2003) adapted the Hopenhayn (1992) model to monopolistic competition in a general equilibrium setting under the conditions of uncertainty to analyse productivity effects of firms’ dynamics under international trade. Contrary to the findings of its predecessors, he predicts that the exposure to trade will induce only the more productive firms to enter the export market and will simultaneously force the least productive firms to exit. The underlying assumption is that there are significant costs associated with entry in the export market. Most of these costs are sunk in nature and are quite relevant for the export decision. Export market entry decisions therefore occur after the firm gains knowledge of its productivity and that only the firms with productivity greater than the threshold level can enter the export market. He calls this export market selection effect. This implies that entry may have significant positive effect on industry level productivity growth in an open economy. He also shows that the least productive firms cannot earn positive profit in the new trade equilibrium and hence exit. This according to him is the domestic market selection effect. The two effects together reallocate market shares towards more productive firms and contribute to an aggregate productivity gain. He shows that an increase in the exposure of an economy to trade generates very similar results. The main claim then is that in an open or transition economy, entry of more productive firms forces the least productive firms to exit which increases aggregate productivity of the industry. This also induces indirect effects on inter-firm market share reallocation towards the more productive firms, further affecting the industry productivity. Thus new entrants are likely to push productivity both directly by being more productive and indirectly by forcing least productive ones to exit. The model does not however explore the possibility that more productive entrants can also affect within-plant productivity of incumbents.

Another strand of literature uses the Schumpeterian creative destruction growth model to predict the potential role of entry and exit. The central premise of this approach is that a part of the differences across plants may reflect the vintage of the installed capital. One form of these models is termed capital vintage approach. It assumes that new technology is embodied in more recent vintage capital. This is because unlike incumbents, they do not have to incur the costs of upgrading their capital. Since technology can be better harnessed by new firms, productivity growth will be dependent upon the entry of new units of production that displace outpaced establishments. Successful firms in innovation enter the market and replace firms producing obsolete goods increasing aggregate productivity of the industry *(inter alia,* Caballero and Hammour, 1994; Mortensen and Pissarides, 1994; Campbell, 1998). These models predict large entry effects. However, an alternative view is that even while new technology is embodied in more recent vintage capital (see *e.g*. Cooper, Haltiwanger and Power, 1999) existing firms can adopt new technology by retooling. This in turn may drive industry level productivity through both within-plant and between plant-reallocation effects. Note that just as Melitz (2003) this model also emphasizes that entry will have not only direct effects but also indirect effects on the macro level productivity. But while Melitz highlights only between-plant reallocation effects, this model introduces the possibility that entry might affect within-plant productivity as well.

Aghion et al. (2009) show that entry effects depend on the technological advancement of incumbent firms. While building on Aghion et al. (2001) they assume that the potential entrant enters with a leading-edge technology. If the incumbent is close to the technology frontier, it will innovate more to escape and survive entry. This is more likely to happen in technologically laggard industries. But, if the incumbent is farther from the frontier, he cannot compete with the entrant and will have to exit. Thus, in technological advanced industries where the incumbent firms cannot survive entry by more productive firms and exit, entry will have only direct effects but in technologically laggard industries entry will induce indirect effects. Thus, entry effects may be relatively smaller in laggard industries as compared with technologically advanced countries.

Finally, product life cycle models (Gort and Klepper 1982, Cohen and Klepper 1996) suggest that firm creation and innovation depend on the degree of maturity of the industry. Geroski (1995) argues that a young industry is characterised by high entry rates as new firms propose a large number of new product designs. As the industry matures, firms stop competing in terms of product design and start competing in terms of prices and costs. Entrants may be at a severe disadvantage in the second type of competition and consequently their impact on industry structure and performance decreases. However, exogenous shifts in demand or costs, may occur and if the incumbent firms fail to adapt to these shifts, entry into the industry may again play an important role.

New entrants can thus be considered to be important agents of change. Their direct effect relates to the generation of new productive capacities while indirect effects relate to the effects they have on established firms in the industry. They can crowd-out less competitive incumbent firms through increased competition to reallocate market shares in favour of more productive firms and /or stimulate incumbent firms to innovate themselves. These *prima facie* effects are however not decisive since new entry could be of small or follower firms *a la* Jovanovic and Hopenhayn, which cannot threaten the incumbents' power. Further, much depends on the industry specific and incumbent firm specific factors *a la* Aghion and Geroski, among others.

4. Empirical testing of firm dynamics and productivity growth: Productivity decomposition methodologies

Empirically, the dynamics of productivity growth are captured by productivity decomposition methodologies. A wide range of decomposition methods are offered in the literature to assess sources of industry productivity growth. These methodologies decompose productivity growth between two points in time in an industry into the contribution from four broad factors: improvement in incumbents' productivity; reallocation of resources from less productive to more productive producers; entry of more productive firms; and exit of less productive firms. These methodologies thus link macro productivity growth with micro firms' and productivity dynamics. Discussed in what follows are these methodologies.

Baily et al. (1992) was the first study to propose decomposition of productivity into the contributions of stayers, entrants, and exits (BHC methodology). They defined aggregate productivity as the output-weighted ($\theta_{f,t}$) average of the productivity of individual plants ($A_{f,t}$). The linear aggregation of productivity implies a geometric average of productivity levels:

$$A_t = \sum_{f}^{n_t} \theta_{f,t} A_{f,t}$$

Using this, they proposed the following methodology (BHC), to decompose aggregate productivity growth:

$$\Delta A_t^{BHC} = \sum_{f \in S} \theta_{f,t-1}\, \Delta A_{f,t} \quad + \sum_{f \in S} \left(\theta_{f,t} - \theta_{f,t-1}\right) A_{f,t} + \sum_{f \in N} \theta_{f,t} \left(A_{f,t} - A_{t-1}\right)$$
$$+ \sum_{f \in X} \theta_{f,t-1} \left(A_{t-1} - A_{f,t-1}\right)$$

In the above equation, the Sets S, N, and X, respectively, represent the set of continuing, entering, and exiting factories during the periods from t-1 to t. The first term measures the effect of plant-level productivity changes, weighted by the initial share. The second term which sums changes in shares using a plant's productivity as weight captures the reallocation effect. The last two terms capture reallocation driven by new plants entering and others exiting.

An alternative is provided by Griliches and Regev (1995). Their methodology is as under.

$$\Delta A_t^{GR} = \sum_{f \in S} \overline{\theta}_f\, \Delta A_{f,t} \quad + \sum_{f \in S} \Delta\theta_f \left(\overline{A}_f - \overline{A}\right) + \sum_{f \in N} \theta_{f,t} \left(A_{f,t} - \overline{A}\right)$$
$$+ \sum_{f \in X} \theta_{f,t-1} \left(A_{f,t-1} - \overline{A}\right)$$

This methodology will be referred to as GR throughout the text of this study. In this formula a bar over a variable indicates the average of the variable over the base and end years. All productivity terms (except for within-effects) are expressed as average productivity of two years.

Foster et al. (2001) modify the BHC methodology. Just BHC, FHK also expresses all productivity changes as differences from aggregate productivity in $t-1$. In addition, they decomposed the second term of BHC into a 'pure between effect', weighing the change in shares by the relative productivity in the initial period and a covariance term. The BHC and GR decompositions amount to lumping the entire covariance term with the between term.

$$\Delta A_t^{FHK} = \sum_{f\in S} \theta_{f,t-1}\,\Delta A_{f,t} \quad + \sum_{f\in S} \Delta\theta_{f,t}\left(A_{f,t-1} - A_{t-1}\right) \; + \sum_{f\in S} \Delta\theta_{f,t}\,\Delta A_{f,t}$$
$$+ \sum_{f\in N} \theta_{f,t}\left(A_{f,t} - A_{t-1}\right) \quad + \sum_{f\in X} \theta_{f,t-1}\left(A_{t-1} - A_{f,t-1}\right)$$

This decomposition has five terms that show the contribution of various components to aggregate productivity change. The difference between the final two is called the net entry effect. In this formula an entering plant contributes positively only of it has higher productivity than the initial average and an exiting plant contributes positively only if it exhibits productivity lower than the initial average. GR measure their distance from the average productivity of both, the initial and end years. Fung et al. (2009) extend the FHK methodology to three period and propose an alternative dynamic classification for businesses. They define several categories such as, continuing survivors, entering survivors, entering failures, and exiting survivors and analyse the contribution of each set of business.

Baldwin and Gorecki (1991) argue that entering firms essentially replace the exiting firms. To properly account for the contribution of firm turnover, they suggest that it is more appropriate to compare productivity between entering and exiting firms. This can be done within the spirit of either the FHK or GR methods. Using the FHK methodology they proposed the following methodology.

$$\Delta A_t^{FHK(X)} = \sum_{f\in S} \theta_{f,t-1}\,\Delta A_{f,t} \; + \sum_{f\in S} \Delta\theta_{f,t}\left(A_{f,t-1} - A_{X,t-1}\right) \quad + \sum_{f\in S} \Delta\theta_{f,t}\,\Delta A_{f,t}$$
$$+ \sum_{f\in N} \theta_{f,t}\left(A_{f,t} - A_{X,t-1}\right)$$

In this formula referred to as FHK, the entry term involves deviation from the average productivity of exiting firms in the initial year and the term for exit term is dropped. In the second version they replace the industry average productivity with the exiters' average productivity in the entry effect term in GR method:

$$\Delta A_t^{GR(X)} = \sum_{f\in S} \bar{\theta}_f\,\Delta A_{f,t} \; + \sum_{f\in S} \Delta\theta_f\left(\bar{A}_f - A_{X,t-1}\right) \; + \sum_{f\in N} \theta_{f,t}\left(A_{f,t} - A_{X,t-1}\right)$$

Olley and Pakes (1996) proposed an entirely different approach, referred to OP hereafter. They defined aggregate productivity as the average of the productivity levels and decomposed it in two terms as follows:

$$A_t^{OP} = \widetilde{A_t} + \sum(\theta_{f,t} - \widetilde{\theta_t})\left(A_{f,t} - \widetilde{A_t}\right) = \widetilde{A_t} + \operatorname{cov}(\theta_{f,t}, A_{f,t})$$

where $\widetilde{A_t} = \frac{1}{n_t}\sum_{i=1}^{n_t} A_{f,t}$ and $\widetilde{\theta_t} = \frac{1}{n_t}\sum_{i=1}^{n_t} \theta_{f,t}$.

The first term is the unweighted productivity average and the second term captures allocative efficiency i.e. to what extent ‘above average size’ firms have ‘above average productivity’. This decomposition distinguishes between the contributions of productivity improvements and reallocation but does not allow us to distinguish between contributions of surviving, entering and exiting. Melitz and Polanec (2009) extended this decomposition to assess the contribution of entering and exiting firms to productivity growth. This methodology is termed as “dynamic Olley and Pakes” method (hereafter referred to as DOP in the text). They challenged the FHK and GR decomposition methodologies on the grounds that their choice of reference productivity values for entering and exiting firms, and the use of fixed weights in distinguishing between contributions of productivity improvements and market share reallocation of surviving firms has mixed up various effects and hence introduced bias in the measurement. In order to eliminate these biases, they used Olley-Pakes decomposition and modified it capture firms’ dynamics. It is given by

$$\Delta A_t^{DOP} = \Delta\widetilde{A_{S,t}} + \Delta\operatorname{cov}(\theta_{S,t}, A_{S,t}) + \theta_{N,t}\left(A_{N,t} - A_{S,t}\right) - \theta_{X,t-1}(A_{X,t-1} - A_{S,t-1})$$

where $\theta_{g,t}$ and $A_{g,t}$ represent the aggregate market share and aggregate productivity of group g in period t.

There are two major differences between the components of the above methodology and those of FHK and GR. First, both entry and exit effects in this methodology are weighted by corresponding overall market shares. The other two decompositions compare aggregate productivity of entering and exiting firms to either aggregate productivity of all firms in initial period (FHK) or the unweighted time average of aggregate productivity of all firms (GR). Second, this methodology does not assign weights to productivity change of continuing firms (within plant effects) as the other two methods and follow instead the approach of Olley-Pakes decomposition, and define reallocation only when covariance between market share and productivity increases. Mathematically, the three methodologies may yield very different results depending on features of firms' dynamics in the data. In an industry where the productivity of continuing firms is growing, FHK decomposition yields lower contribution of exiting firms than the DOP, whereas the opposite holds for the GR decomposition. Further, both FHK and GR decompositions yield smaller contribution of surviving plants and larger contribution of entering plants as compared with DOP. Finally, the within effects are inflated in FHK and GR due to the use of weights in measuring these effects, which according to Melitz and Polanec (2009) captures a part of reallocation effect[1].

Clearly, there are a wide range of estimates in the literature. Foster et al. (2001) show that the results are sensitive to the choice of methodology, time-period, and productivity measure. The present study uses three methodologies of decomposition for the robustness of the results. These are: GR, FHK and DOP.

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1 In the recent literature, regression based methodologies have also appeared for the decomposition analysis. Foster et al (2006), for instance, regress productivity on indicators of entry and exit, obtaining a regression analogue to a decomposition of productivity growth to entry and exit effects and growth in continuing firms. Nevalainen (2010) shows that point estimates for the different terms of the dynamic OP decomposition can be obtained by focusing on two time periods and by regressing firm level productivity on appropriately scaled share data on surviving incumbents, entrants and exits. Hyytinen et al. (2010) use a standard moment-based GMM procedure to compute estimates for the components of the Olley-Pakes productivity decomposition and to estimate their standard errors. This methodology is not followed in this paper.

5. Literature review

There has been a proliferation of studies on productivity analysis using decomposition methodology since the seminal work of Baily et al. (1992). We briefly review here the findings of the existing studies to examine whether the sources of productivity differ across developed and developing countries (see also, Kocsis et al. 2009, UNIDO 2009). Table 1 presents the findings and methodologies adopted by the existing studies. It may be observed that decomposition analysis is highly affected by the methodology used, weights assigned and whether labour productivity or TFP is used. The methodology of Foster et al. (2001) For instance, attributes 0.3447 for surviving firms, 0.0990 to entrants and 0.0596 to exiting firms in Slovenian productivity growth for 1997-2001. But Melitz and Polanec (2009) used a dynamic Olley Pakes decomposition and found significantly higher overall contribution of surviving firms (0.4490) and a negative contribution of entering firms (-0.0225). Even the same methodology with different weights and different measures of productivity can produce remarkably different results. For instance, Foster et al. (2001) find the contribution of reallocation to be -30% in Germany for the period 1993-2003 when they weight labour productivity by labour. It turns positive and as large as over 58% if they replace labour by output as weight in the measurement of labour productivity. Notwithstanding the differences in the actual numbers, some interesting patterns emerged.

- Except in a few industries, new entrants do not account for large contribution to productivity growth in developed countries. Within-firm effects turn out to be rather large. Since these reflects firms' own innovation activities one may expect that they will dominate productivity growth in advanced countries as these countries have a human capital base and resources for research and development. Another reason for why this may be the case is that incumbent firms are under a constant threat of entry.

They have to adopt the escape entry route to survive the threat. They enjoy the relative advantage of size and experience and hence manage to keep the entry effects small. Within effects are rather large in the least developed countries (Haltiwanger 1997) also, but for very different reasons. In these economies other effects are negative and therefore if productivity growth occurs, it is due to firms' own initiatives.

- In transition and fast growing economies entry effects become important along with the with-in effects. Other effects are not very significant. The structural change process may emerge in the long run in these economies when new firms grow larger. Fast growing economies of Taiwan and Korea exhibit similar patterns.

Table 1: Review of existing studies

Method	Country	Period	method	Productivity measure	Within	Between	Cross	Entry	Exit
FHK (2001)	US	1992-97	FHK	LP	109.00%	-3.00%	-24.00%	-29.00%	49.00%
Baily et al. (1992)	US	1982-87	BHC	TFP	68.5	23.5		8.0	
Haltiwanger (1997)	US	1982-87		TFP	43.2	12.6	35.5	8.7	
Foster et al. (2006)	US	1987-97	FHK	LP	16	24	-39	98	45
Baldwin & Gu (2006)	Canada	1989-99	BG	LP	31.3	39.8		28.9	
Bladwin and Gu (2006)	Canada	1988-97	BG	LP	-0.98	-0.09	0.22	-0.09	-0.06
Griliches and Regev (1995)	Israel	1979-88	GR	LP	88.0			12.0	
OECD (2001)	OECD	1980s-1990		TFP	60-85	0-20		10-40	
FHK (2001)	Western Europe	1993-2003	FHK	LP	48.00% in UK to 118% In Germany	-21 in Spain to 29 Belgium	-30.00% -58 in Germany	35.00% in UK to -11 in Finland	3.00% in Netherlands to 30% in Portugal
Balk & Sppiker (2003)	Netherlands	1984-99		LP	87.0	10.0		3.0	
Carreira and Texeira(2009)	Portugal	1996-2000	DOP	LP and TFP	89-67	4 to 7	3-4.7	bbb-1.1 to -1.8	30 to 6
Disney et al. (2003)	UK	1982-87		TFP	-0.41	(-0.03)	-0.51	-0.12	
Fukao and Kim (2006)	Japan	1990-2003		TFP	-0.49	(-0.03)	-0.31	-0.53	-0.29
Fukao and Kim(2006)	Japan	1990-2004		LP	-0.48	-0.12	(-0.01)	-0.64	-0.23
McLellan (2004)	new Zealand	1995-2003		LP	850	594.4	-1294.4	-127.8	77.8
FHK (2001)	Transition economies	1990-2005	FHK	LP / TFP	Ukraine -0.39 to Slovenia 68	-4.86 Hungary to 40 Latvia	Latvia is -24-30.8 Ukraine	Hungary 80 to 15 Slovenia	Latvia -1 to 23 in Estonia
Brown and Earle (2010)	Transition economies	1990-2005		TFP and LP	Ukraine -.4 to 59 Romania	-3 in Hungary to 13 Ukraine	-.27 Hungary to 30 Ukraine	Hungary 80 to 40 in Lithuania	Hungary 3 to 11 Lithuania
Melitz and Polanec (2009)	Slovenia	1996-2001	DOP	LP and TFP	10%-33%		1.8 to 12	.21 to 2.25	.77 to 7.68
Fukao and Kwon(2005)	South Korea	1990-98	FHK	TFP	-0.4	(-0.08)	-0.1	-0.56	-0.02
FHK (2001)	Korea , Taiwan	1988-93	FHK	LP	72.00% Korea, 74	8.00% Korea-17	-13.00% Korea--22taiwan	15.00% Korea-17	25.00% Korea-20 Taiwan

				Taiwan	Taiwan		Taiwan	
Fung et al. (2009)	Taiwanese electronics	1986-1991	FHK TFP	0.664322001	0.040250098	-0.088315748	0.379445096	0.004298554
Biesebroeck (2005)	Colombia	1981 - 1991	Parametric method TFP	14-20				
Foster et al. (2001)	Chile	1985-2001	FHK LP	95.00% Chile to 125 Argentina	25.00% Chile to 20 Columbia	-50.00% Chile to -45 Columbia	Argentina -5 to -20 Columbia	Argentina 10 to 40 Columbia
Haltiwanger (1997)	Africa	1990-95	Parametric method LP	Ghana 79 to 445 Kenya	Cote devoir 7.3 to -26 Cameroon	Zâmbia -278.6 to -6.34 cote d vore		
Biesebroeck (2005)	Zimbabwe	1993 - 1995	BHC and GR TFP	Decline 86-97				

Source: Compiled from various studies

6. Methodology and database: The present study

This study aims to analyse the effects of entry on macro productivity growth in Indian manufacturing for the period 2000-2006. In what follows we discuss the methodology adopted for the analysis.

Decomposition methodologies: As stated above, the size of different components of aggregate productivity decompositions depends on the choice of the method of decomposition. For this reason we use three decomposition methodologies to analyse the impact of entry (and exit) on productivity in India during 2000-01 to 2005-06. These are: GR (1995), FHK (2001), and DOP (2009). The results will be analysed in a comparative analytical framework to check the robustness of results.

Productivity measure: The most frequently applied measures of productivity are : labour productivity (LP) and total-factor productivity (TFP). As the latter accounts for the distinct effects of capital/labour inputs together with technological progress, it is often seen as favourable. However, due to the lack of proper capital stocks at micro level, it is not possible sometimes to measure total factor productivity. Therefore, the “second best” measure i.e. labour productivity is employed in several studies. Haltiwanger (1997) argues that the measurement of labour productivity (particularly on a gross output basis) is less fraught with measurement problems than measures of total factor productivity (TFP). Thus the risk of error measurement is lower in this case. The present study also uses labour productivity for the analysis. The industry level productivity is measured as a weighted average of plant level productivity. It is defined as:

$$A_t \equiv \sum_{f}^{n_t} \theta_{f,t} \left(\frac{GVA}{L}\right)_{f,t}$$

Weight (θ): Different parameters have been used as weights in the existing literature. These are: share of revenue, output, labour, value added, or costs. Foster et al. (2008) assert that the choice of weight is "an open question". The most common choices are either output (or revenue) weight or employment weight. Following the traditional literature, we have used 'output' weight in the present study.

Real Gross Value Added (GVA): We obtain GVA using double-deflation method as follows:

GVA= (gross value of output)/(wholesale price index)-(total input)/(input price index).

Gross value of output (GVO) is deflated by the wholesale price index while inputs are deflated by the input price index. The input price index is constructed as the weighted average of fuel price, material price, and other input prices. Fuel price, material price and other input prices are constructed using wholesale prices, implicit deflator of national account statistics and weights from input-output tables. The data sources we use for constructing input price index are: Reserve Bank of India, *Handbook of Monetary Statistics of India* and *Database on Indian Economy*; Central Statistical Organisation, *Input-Output Transaction Table*.

Labour Input (L): Two indicators of labour are used to measure labour input: the number of workers, and man-hours of workers. Since the results are not different, we report here only man-hours based results to avoid multiplicity of results.

Our empirical application is based on plant or ''factory'' level data for the period 1998-99 to 2005-06, which is collected by the Central Statistical Office of India in the Annual Survey of Industries (ASI). The primary unit of enumeration in the survey is a factory in the case of manufacturing industries, and data are based on returns provided by factories. The schedule canvassed is in two parts. Part I aims to collect data on capital structure by type of assets, work- force by sex and category of workers, wage bill by type of payments, consumption by broad categories of inputs, output by type of products and by-products etc. Part II aims to collect data on different aspects of labour statistics, namely, working days, mandays worked, absenteeism, labour turnover, man-hours worked, earnings and social security benefits. The present study uses data on various plant level production parameters such as output, sales, labor, employees, capital, materials and energy.

The ASI factory frame is classified into 2 sectors: the 'census sector' and the 'sample sector'. The sample sector consists of small plants employing 20 to 99 workers if not using electricity and 10 to 99 workers if using electricity. The census sector comprises relatively large plants. It covers all units having 100 or more workers and also some significant units which although having less than 100 workers, contribute significantly to the value of manufacturing sector's output.. While the units in the census sector are approached for data collection on a complete enumeration basis every year, sample sector units are covered on the basis of a well designed sampling. The present study focuses only on the census sector data for the decomposition analysis. This is because the productivity decomposition analysis requires a consistent and exhaustive database to distinguish between continuing firms, entrants and exiters. A challenge was however posed by changes in the definition of the census sector in the recent past. For the year 1997-98, 1998-99 and 1999-2000, the census sector was limited only to factories employing 200 or more workers. From 2000-01 onwards again the factories employing 100 or more workers are under the census sector. For consistency in the analysis, we exclude the years prior to 2000-01 from our analysis and focus on the period 2000-01 to 2005-06. The composition and number of plants are summarized in Table 2.

Table 2 : Composition of plants by year and sector

year	Census	Sample	Total
2000-2001	12,297	9,930	22,227
2000-2002	14,532	10,242	24,774
2000-2003	11,264	16,341	27,605
2000-2004	11,207	20,185	31,392
2000-2005	14,122	12,611	26,733
2000-2006	17,826	1,748	19,574
Total	81,248	71,057	152,305

In the original data the industrial classification of factories for the period from 2000-2001 to 2003-04 is based on NIC 1998; from 2004-05 onwards NIC 2004 is used. Using the concordance tables, we reclassified the factories using NIC 2004 for the period prior to 2003-04.

Another important challenge was to distinguish between entering and exiting firms categories of firms over the period of five years. Since our database comprises of relatively larger units (100 employees or more), entry of new plants is accounted for by not only newly established plants but also by those plants that were already existing in the sample sector but they have expanded and subsequently shifted to the census sector during the study period. These two categories of entering firms need to be differentiated because of the different dynamics that they might have undergone. As suggested by Jovanovic, (1982) and Hopenhayn (1992) newly established plants may be equipped with cutting edge technology but under the assumption of uncertainty, their productivity is relatively lower as they are inexperienced. If they are successful through passive learning or active explorations they survive, grow and enter the large sector by way of expansion. The two categories of plants are thus expected to have very different outcomes. Newly established firms are expected to have much smaller contribution than the winners. Our analysis may thus offer better understanding of the plant dynamics and their effects on productivity. Another form of plant dynamics that we observed in the data was the phenomenon of switching-in and switching-out of the industrial classification. Some plants changed their industrial classification during the study period and switched over to other industrial categories. Separate categories were created for these groups to capture the effects of their dynamics. Finally, the exiting firm is defined as the firm that stopped functioning or downsized its operations during the study period. It might not have wound up it operations due to the tight exit policy but it might have become sick and downsized their production activity to join the small sector. In all, therefore, we define 6 categories of plants. Their definition and notations are provided in Table 3.

Table 3: Plant Status Variables

Status	Notation	Definition
Continuing survivors	CS	Present in both period t and t-k in the census sector
Entering survivors	ES	Present in t in the census sector and t-k in the small sector
New entrants	EN	Present in t in the census sector, absent in t-k
Exiting plants	EX	Present in t-k in the census sector, drop out in t
Switching in survivors	SS	Present in t in the census sector in industry i, absent in t-k in industry i
Switching out survivors	SO	Present in t-k in the census sector in industry i, absent in t in industry i

It required a careful examination of all sample and census sector firms to identify different categories of plants. Table 4 summaries definitions of the effects used in the study.

Table 4: Components of productivity decomposition

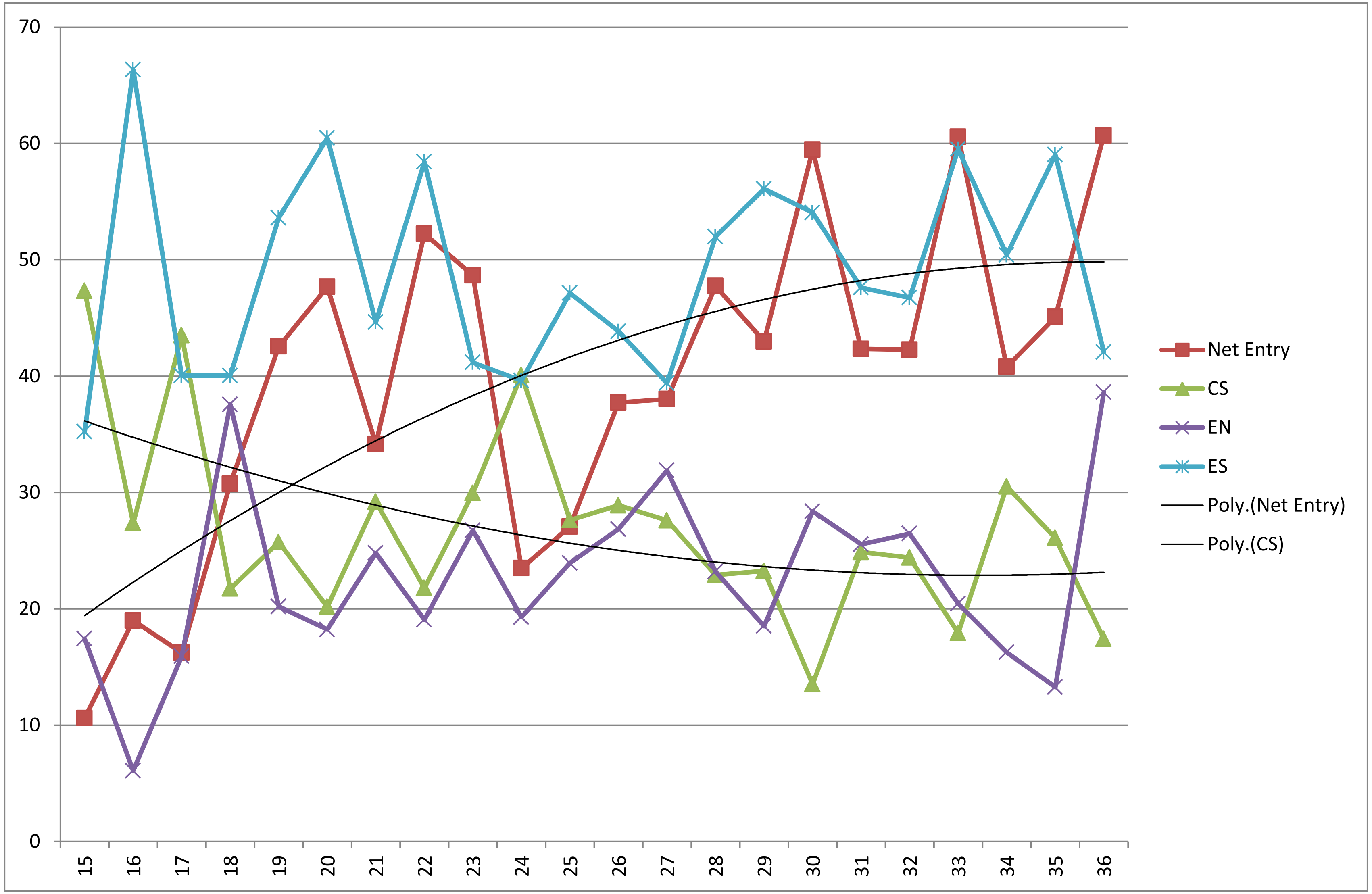
Effect	Definition	Clarification
Total entry effect	TE= EN+ES+SS	Effects of newly entering, expanding and switching-in firms
Total exit effect	TX= EX+SO	Effects of exiting, downsizing and switching-out firms
Net entry effect	NE=TE+TX	This is the effect of the process of creative destruction
With-in plant effect	Within-effect	This signifies the effects of CS
Reallocation effect	Between plant effects + covariance	It shows improvement in allocative efficiency.

7. Business dynamism in India: 2000-01 to 2005-06

Our data set covers plants in both, the cross-sectional and time series dimensions. We therefore identified firms' dynamics during 2000-1 to 2005-06. Figure 1 presents a comprehensive picture of plant dynamics during 2000-01 to 2005-06 at two digit level. It must be noted that the industry group 15-21 comprises of traditional industries: food, textile, apparel, wood and paper. These are matured and least technology intensive industries. Industries ranging from 23 to 28 are chemical and metal based industries which in general are medium tech industries requiring large investment. Finally, the classification 29 to 35 pertains to high technology intensive industries. Industry 36 is composed of miscellaneous industries.

The number of plants increased across all industries without any exception over this period. Overall, the number of plants in our dataset increased by 45 per cent, from 12,297 in 2000-01 to 17,826 in 20005-06. Of the total 17826 plants, a mere 5802 (32.5 percent) plants are continuing survivors (CS). The rest are either newly established plants (EN) or entering survivors (ES). The latter were originally small sized plants classified in the sample sector but have expanded and upgraded to qualify for the census sector. Their share varies from 40 percent to 60 percent across industries. The share of newly established plants in the total number of plants in 2005-06 varies from 6 percent in tobacco industry to as high as over 38 percent in the ‘miscellaneous’ category. Overall, the share of total entrants ranges between 60 to 80 percent. A closer examination of the trends in CS firms reveals that the share of survivors has been lower in relatively higher technology and capital intensive industries as compared with traditional industries. This does not mean that these sectors witnessed a decline during this period. On the contrary, this is the outcome of the restructuring process in which old firms destructed and new firms entered. This is manifested in the patterns of net entry. Net entry rates show an upward movement as we move from traditional to modern technology and capital intensive industries (figure 1). There is thus a clear evidence that the manufacturing sector underwent tremendous transformation during this period. The change is effected in all industries. But the process of creative destruction seems to be rather intense in the modern sector which is technology and capital intensive. The two exceptions are the chemical, and rubber and plastic sectors. On the other hand, some of the traditional industries such as wood and leather also seem to have undergone significant plant dynamics. A pertinent question is how these micro dynamics affected macro productivity growth.

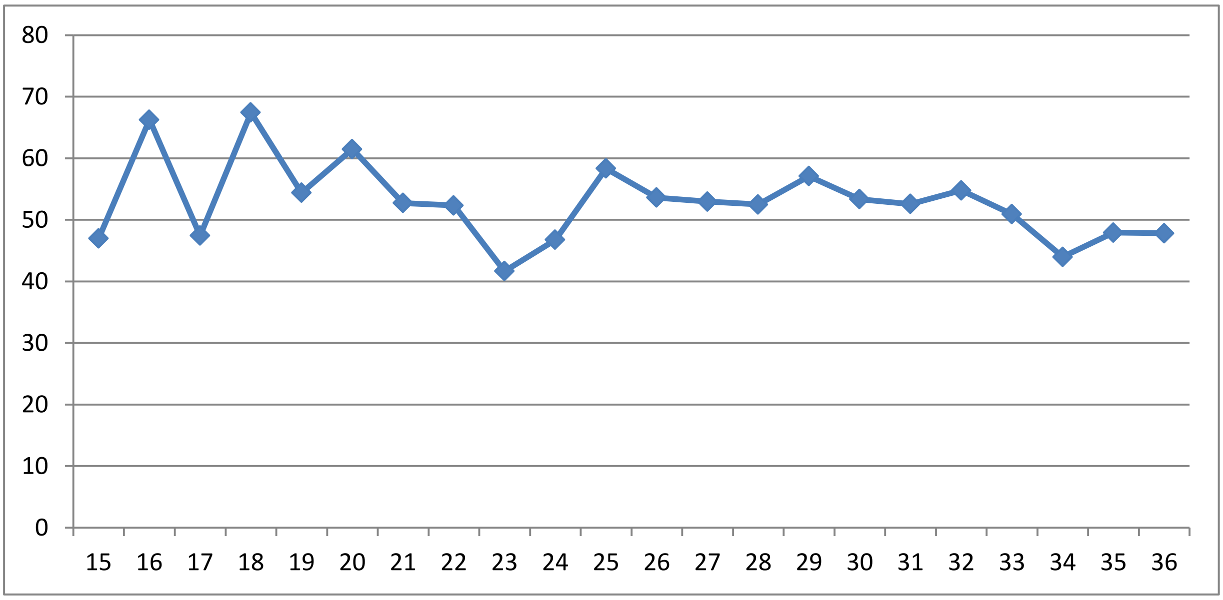
Figure 1: Plant dynamics in Indian manufacturing during 2000-2006 (%)



Note: ``Poly.(net entry)" represents net entry trend line while ``Ploy.(CS)" shows the trend line for CS.

Figure 2 shows the share of plants that exited from our data over this period, by industry. As stated above, exiting plants either closed their business down or reduced the scale of their operation such that they were reclassified in the small sector. It shows that 50 to 60 percent of the plants functional in 2000-01 stopped functioning by 2005-06. Over all, of the 12297 plants operational in 2000-01, only 5982 (48.6 percent) survived by 2005-06 while the rest 6315 (over 51.4 percent) exited. The distribution of these plants is fairly uniform across industries. However, some of the traditional industries such as tobacco, apparel, leather and wood industries witnessed a rather high rate of firms' exit ranging from 60 to 70 percent. On the other hand, technology intensive electronics machinery, instruments, motor vehicle and transport equipment industries had an exit rate ranging between 50 to 60 percent. Petroleum and coke, chemicals and transport (including auto) industries have experienced the lowest exit rates but it also varied between 40 to 50 percent. Thus there have been significant business dynamics taking place in the economy, in which the plant casualty rates are rather high. It is therefore important to have a well designed exit policy to facilitate their exit.

Figure 2: Share of firms exiting plants in the post 2000-01 by industry period (%)

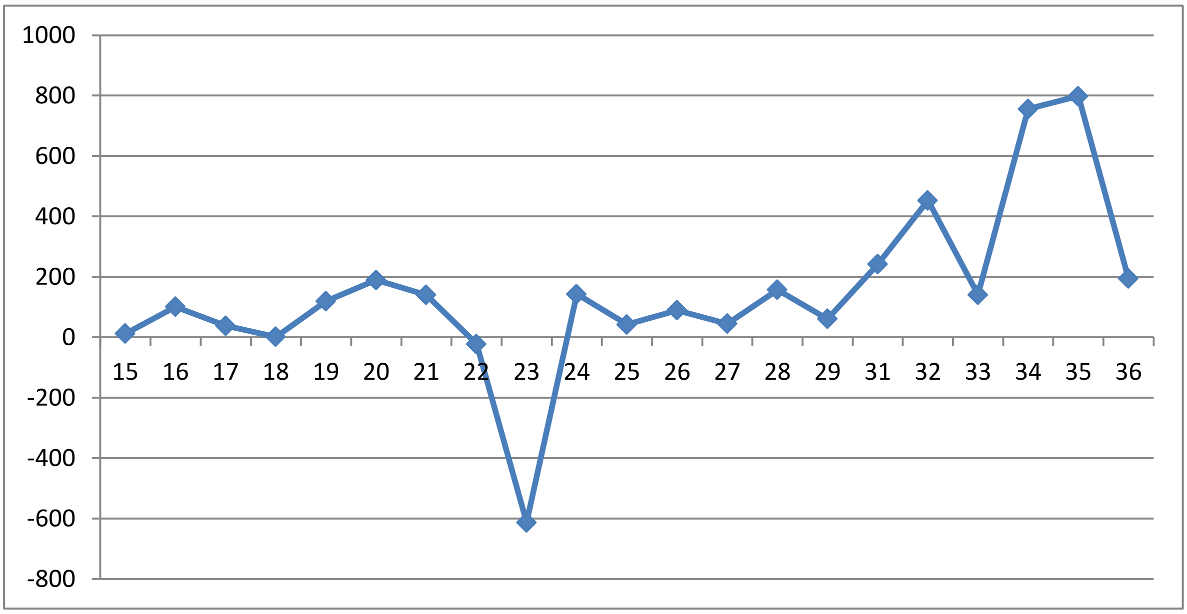


8. Plant dynamics and productivity growth: Empirical findings

Labour productivity growth

Figure 3 presents labour productivity growth rates across two digit level industries in Indian manufacturing over the period from 2000-01 to 2005-06. It shows that labour productivity has increased across all the sectors over this period with coke and petroleum industry being the only exception. The strongest productivity growth has come about in the office computing machinery industry. Productivity grew over 34 times over this period and is not shown in the figure due to scale problem. Another interesting pattern that emerges is that the productivity growth has been relatively higher in high tech industries with the only exception of heavy machinery industry despite high rates of net entry.

Figure 3: labour productivity growth across two digit level industries: 2000-01 to 2005-06



Decomposition of productivity: The manufacturing sector

Table 5 presents the decomposition results for Indian manufacturing based on FHK, GR and

DOP methodologies. Entry effects comprise of three components : entry of newly established plants (EN), entry of existing plants due to their expansion, and entry of the existing firms on account of switching away from other industrial category. While the GR decomposition attributes 6 percent of productivity growth to entry effects, FHK estimates it to be 23 percent. On the contrary, the DOP decomposition reveals that the new entrants pulled the aggregate productivity down. Further, the effects of newly established and switching-in plants have been rather small across all the decompositions. On the other hand, entry effects of ES firms are relatively larger. Exit effects are positive for both the FHK and GR methodologies signifying the exit of less productive firms. But DOP shows that more productive firms exited affecting the macro productivity adversely. Overall, FHK and GR attribute 25-15 percent of total productivity growth to the process of creative destruction (net entry effect). Continuing firms contributed 79-84 percent of total productivity with the within-effect dominating productivity dynamics. DOP on the other hand, shows that the creative destruction process has actually had a negative impact on the industry level productivity. Productivity growth occurred due to reallocation of market share in favour of more productive existing firms in the manufacturing sector. This was partly offset by the negative effects of business dynamics.

Table 5: Decomposition of labour productivity growth over 2000-1 to 2005-06

	Within	Reallocation effect	Total CS effect	EN	ES	SS	Total entry effect	EX	SO	Total exit effect	Net entry
FHK	57.917	20.715	78.633	1.459	14.073	8.143	23.675	1.665	0.643	2.308	25.983
GR	69.484	15.021	84.505	-1.653	2.672	5.033	6.052	9.246	0.197	9.443	15.495
DOP	4.692	116.194	120.886	-5.877	-12.804	0.812	-17.87	-2.323	-0.693	-3.017	-20.887

The results are conflicting. While FHK and GR methodologies show that plants dynamics made a sizeable contribution to productivity in Indian manufacturing, DOP presents a rather pessimistic view of this. Further, both FHK and GR methodologies attribute significant productivity growth to within-plant efforts. The DOP methodology suggests that this was due to structural change in manufacturing in which the market share of more productive firms increased. Melitz and Polanec (2009: 9-10) recognize the possibility of conflicting results and argue that the gap between DOP and other methodologies increases with the speed of productivity improvements of surviving plants, the productivity advantage of surviving plants over entering and exiting plants and the difference between market shares of entering and exiting plants. In short, productivity growth and industry structure matter. Since these characteristics vary widely across industries, a more disaggregated analysis is required.

Decomposition by industry

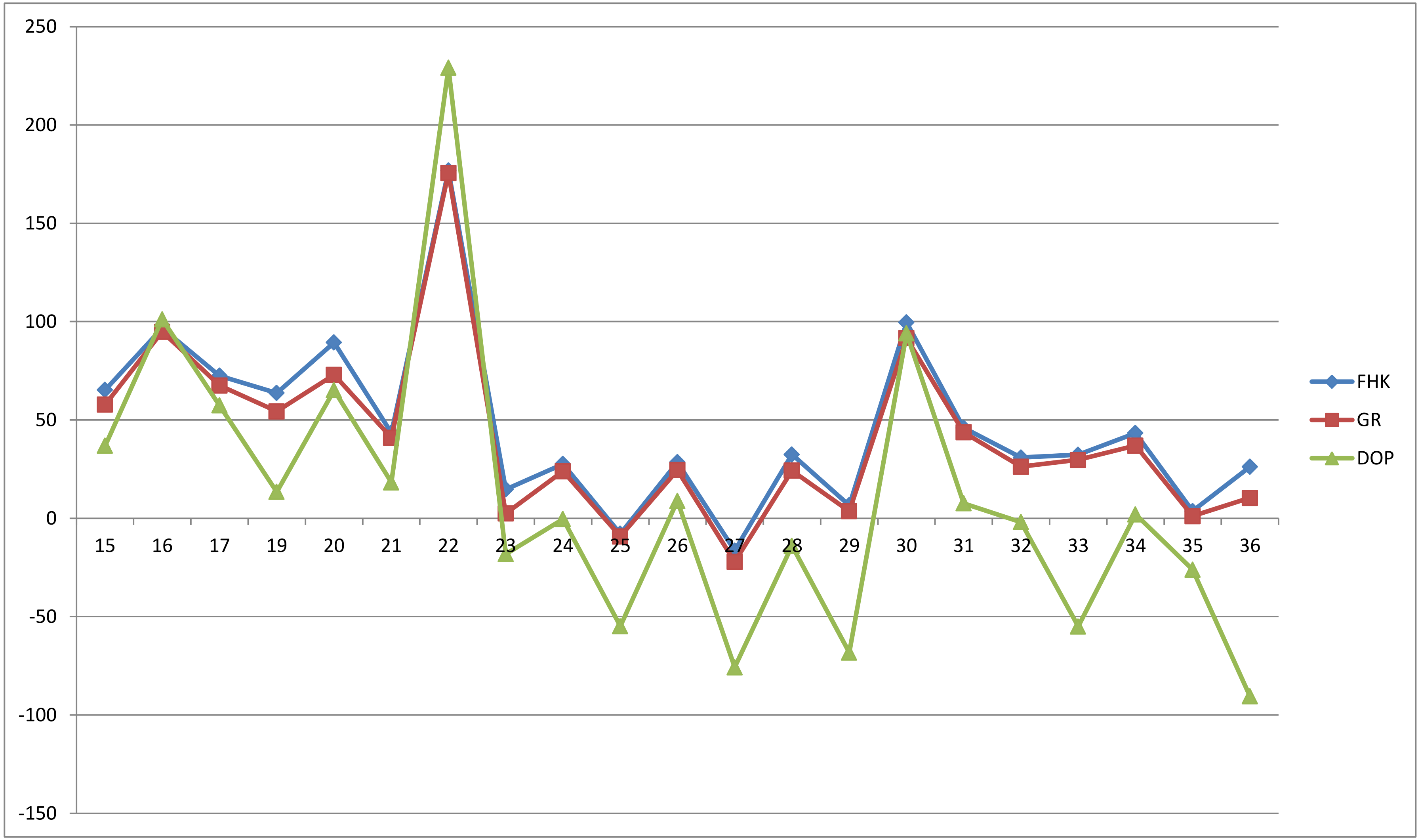
Figure 3-6 present industry-wise decomposition results based on DOP, FHK and GR methodologies across 21 two-digit level industries over 2000-01 to 2005-06. Apparel industry was found to be an outlier showing rather large effects and hence is excluded from the analysis. It may be seen that the patterns are consistent across different methodologies even while the actual percentage values differ. Table 6 presents correlation coefficients between estimates derived from different methodologies. With effects of DOP seem quite at variance with FHK and GR. The remaining effects yield almost the same patterns.

Table 6: Correlation coefficients between measured effects using different methodologies

	Entry effect	Net entry effect	Exit effect	Within-effects	Reallocation effect
FHK and GR	.97	.92	.96	.88	.82
FHK and DOP	.87	.91	.97	.21	.64
GR and DOP	.88	.84	.85	.41	.73

Net entry effects: Figure 4 presents the contributions of net entry to productivity growth based on FHK, GR, and DOP methodologies. It may be observed that DOP methodology yields consistently smaller net entry effect. Three observations may be made. One, the contribution of plant dynamics to labour productivity growth has been quite substantial accounting for between -99 per cent to 250 per cent of productivity growth. Two, in most cases it is positive.

Figure 4: Net entry effects by industry: 2000-01 to 2005-06



Rubber and plastics, and basic metals are the only two industries where it is consistently negative across all methodologies. Three, the process of creative destruction seems to have contributed most prominently to labour productivity in traditional industries. This could be because these industries are not scale, technology or capital intensive. Knowledge is diffused in the economy. New plants can therefore compete more effectively with incumbents. This is however in contradiction with the predictions of Aghion et al. (2009) and Geroski (1995). They predict small entry effects in technologically laggard and matured industries respectively due to escape entry reaction by incumbents. While the patterns of entry effects do not conform to the theoretical predictions, they are not quite in line even with the empirical findings of Bartelsman et al. (2009). In their study of 15 developing and developed countries, they have found a strong positive effect of new firms in medium high tech industries; in low tech industries it is modest or even negative. On the contrary our results show strong positive effects of entry in low and high tech industries. In medium low tech industries these effects are modest.

But consistent with the theoretical predictions, high tech industry group (29-34) also exhibit substantial net entry effects. Net entry effects are smaller in this group as compared with the traditional industries and range between 30 to over 99 percent. In heavy machinery industry (29) and transport equipments (35) however these effects are rather small. The results for industry 33 (precision instruments) are somewhat conflicting between FHK and GR on the one hand and DOP on the other. Finally, the net entry effect is modest in medium technology intensive industries. While chemical, metal based and non metallic industries seem to have been benefitted by plant dynamics, other industries remained unaffected or were affected adversely.

Entry and exit effects: Total entry effects are consistent with the net entry effect indicating that exit effects are rather small (figure 5). However three major observations need to be made here. The first observation is related with heavy machinery industry. The contribution of new plants to productivity in heavy machinery industry (industry 29) is found to be positive across all the methodologies. It is noted above that the contribution of net entry to this industry has been rather small or negative. Clearly this industry has witnessed exit of more productive firms contributing negatively to the industry productivity. Another major observation is in the context of the publishing and printing industry. Here it is observed that new firms' contribution to the industry is relatively small or even negative (DOP) but the exit of inefficient plants has made a significant contribution to the productivity of this industry. The final observation is related to the tobacco industry. It is noted that the entry effect is rather large in this industry but it is partially offset by the exit of more efficient plants which has pulled down the net entry effect.

Figure 5: Total entry effects by industry: 2000-01 to 2005-06

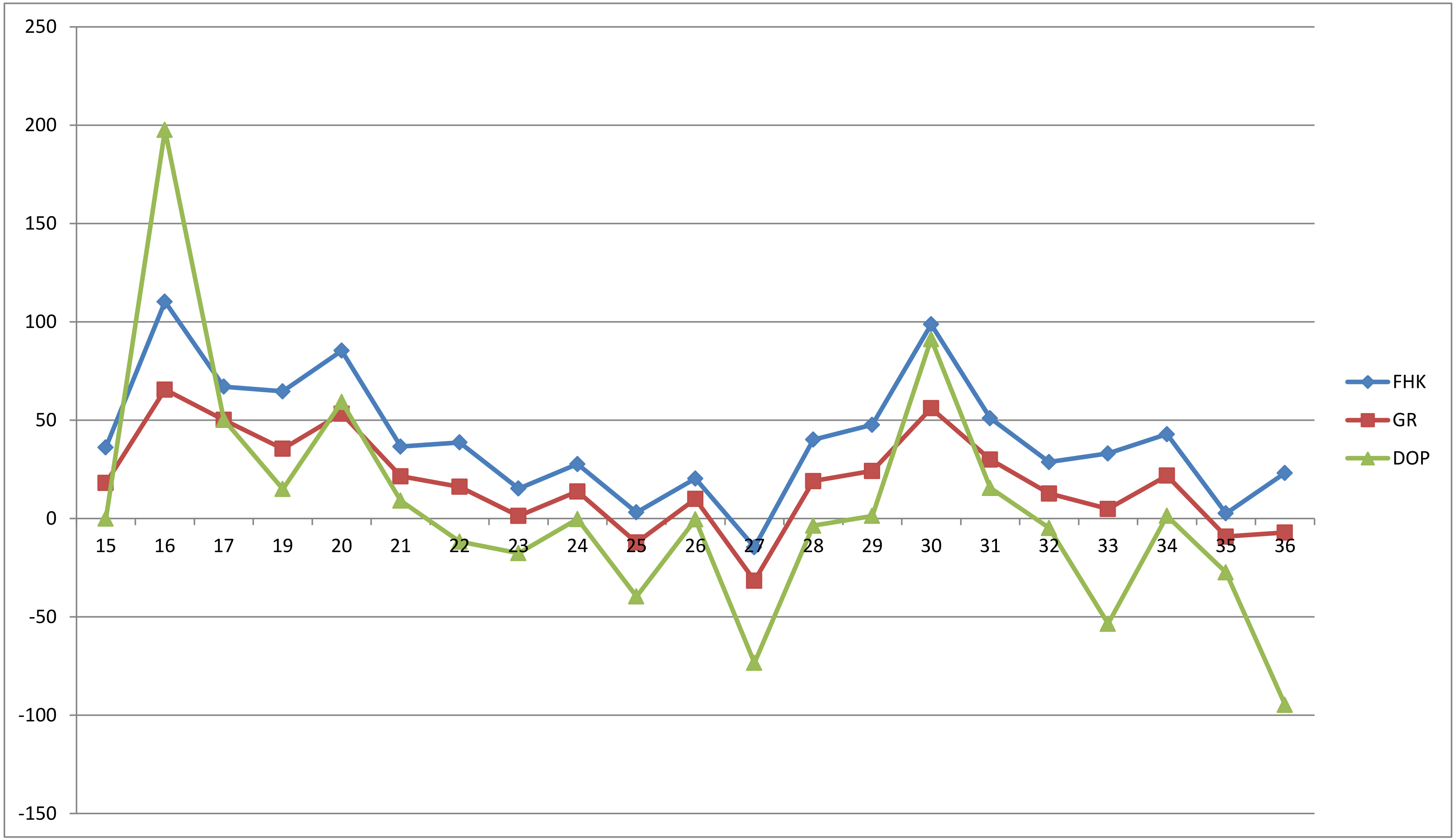
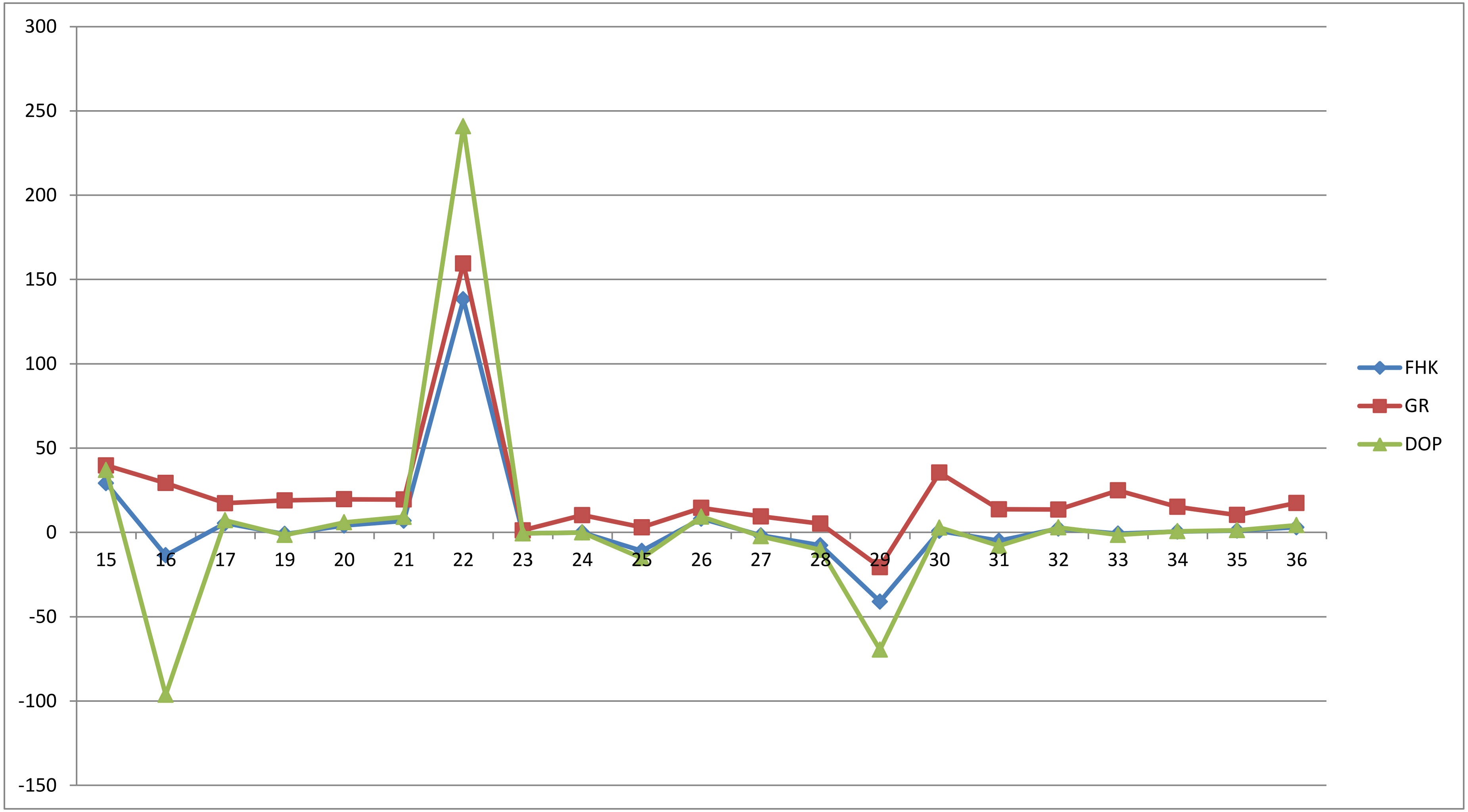


Figure 6 confirms the observations made above. It also shows that exit effects are rather small in all the decompositions but are positive. This also shows that most firms that downsize their activity or report sickness are less productive. Aw et al. (2001) and Foster et al. (2001) also report that the less productive plants are those that exit the market. This pattern is broadly consistent with selection effects as predicted by Hypohayns (1992) and also the Shumpeterian creative destruction hypothesis. They can pull down the industry productivity at macro level. There is thus need for an easy exit policy to facilitate exit of such units.

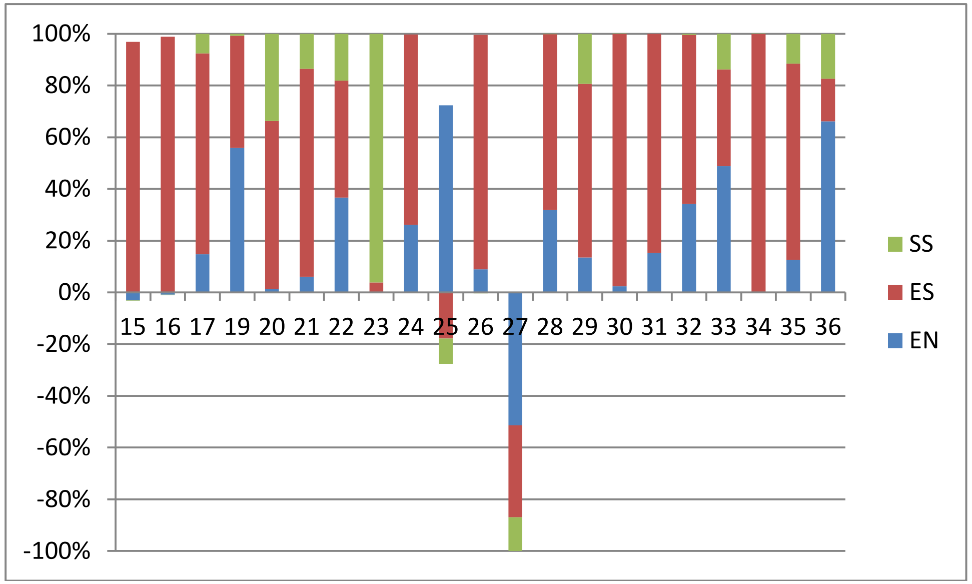
Figure 6: Total exit effects by industry: 2000-01 to 2005-06



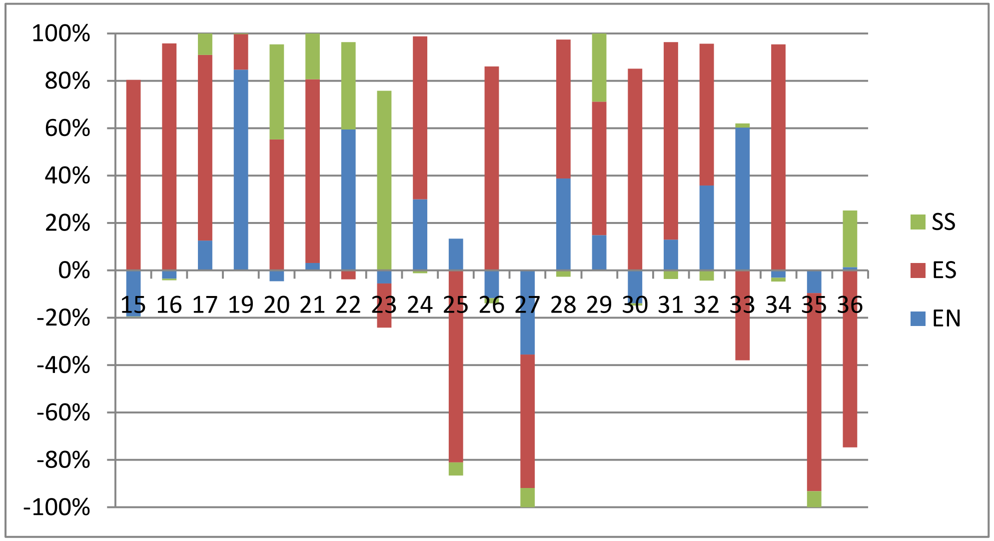
In what follows we present the decomposition of entry effects (figure 7). As expected, the expanding existing plants (CS) dominate the entry effect in most industries. There are some exceptions though. For instance, switching-in effects dominate the petroleum and coke industry. Switching-in effects are also substantial in heavy machinery, wood and paper industries. There is some evidence of newly established plants making strong effect on productivity but it remains limited to leather, chemicals and fabricated metals.

Figure 7: Decomposition of total entry effects: FHK, GR and DOP

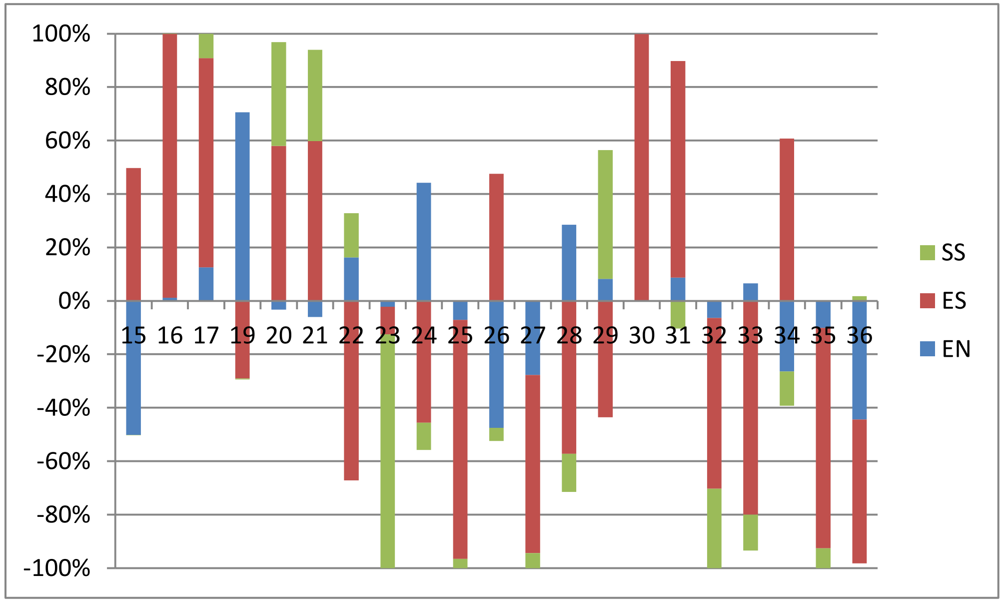
FHK



GR



DOP



This provides some support to the passive (or active) learning models which suggest that new firms are in a learning or exploration phase. Their impact on industry productivity may be rather small. If they succeed, they survive and grow. Eventually they move to larger size class. Our results suggest that successful plants make a significant contribution to industry productivity as they enter the larger size class, even while continuing firms dominate them.

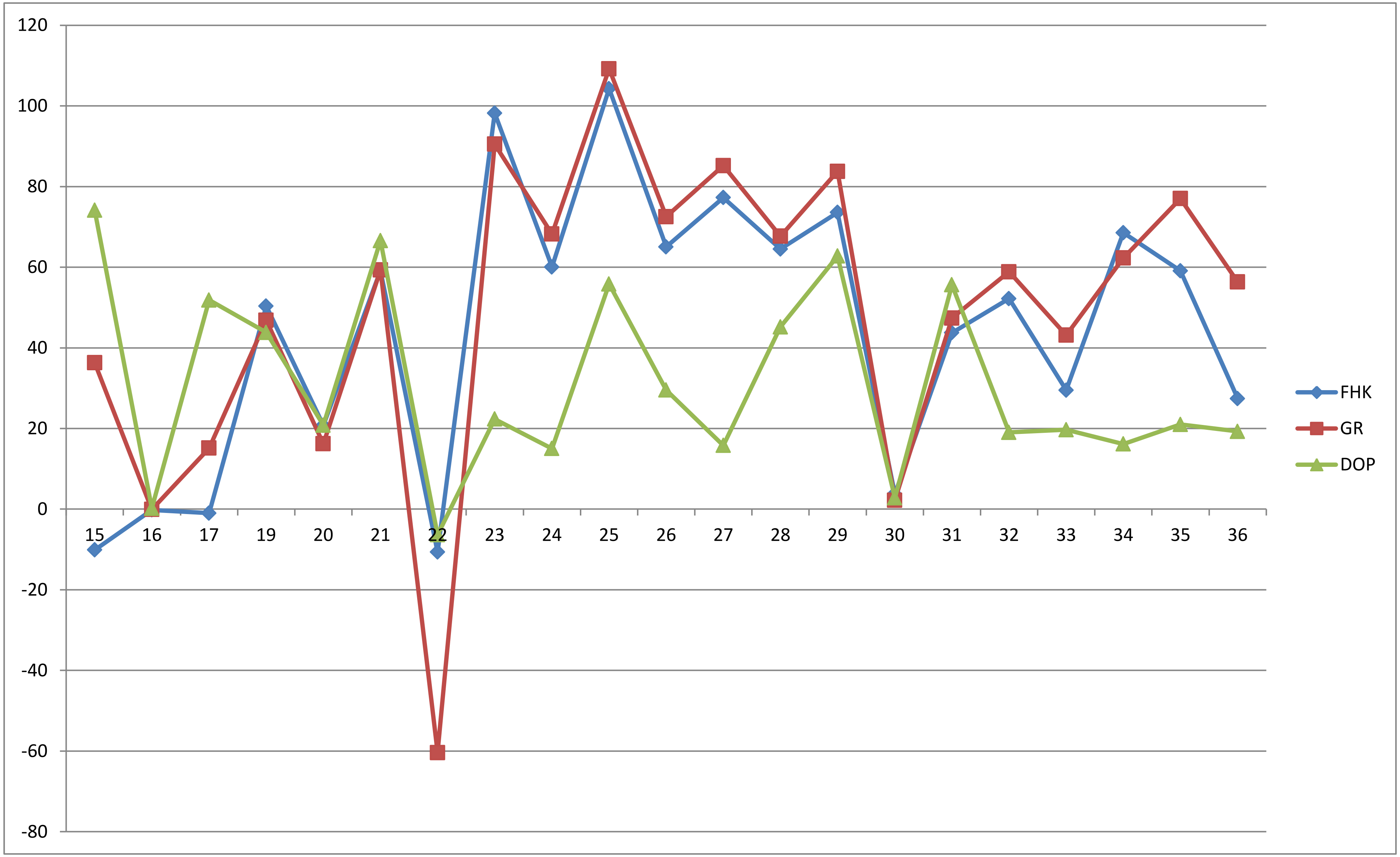
This is further confirmed by Table 7 which shows correlation between entry and different components of productivity growth. It shows that while new plants have rather small entry effect, entry of plants that grow and enter the large size class has a large positive correlation with entry effect. There is thus clear evidence of substantial entry effects of surviving entering firms in India. But the entry of new plants also seems to pose threat to existing plants and puts pressure on them to improve productivity. Similarly it also leads to reallocation of resources in the industry. Similar results have been reported by Bartelsman and Doms (2000), Aw et al. (2001) and Foster et al. (2001), who have interpreted this result as consistent with selection and learning forces.

Table 7: Correlation coefficients between firm entry and components of productivity

	FHK	GR	DOP	FHK	GR	DOP	FHK	GR	DOP
Effect	Within	Within	Within	Reallocation	Reallocation	Reallocation	Entry	Entry	Entry
EN	0.30	0.32	0.01	0.17	0.36	0.44	-0.43	-0.5	-0.61
ES	-0.23	-0.41	-0.4	-0.36	-0.18	-0.22	0.51	0.42	0.46

Within effects: As expected, the DOP methodology yields much lower estimates for within-effects than GR and FHK methodologies. Sometimes they also present conflicting picture. However, that is by exception than rule in this case. Most results are consistent (figure 8). Within effects are positive and significant in most cases accounting for upto 100 percent productivity growth (as in rubber and plastic industries). While entry effects are large in low and high tech industries, within effects are relatively stronger in the medium technology intensive industries.

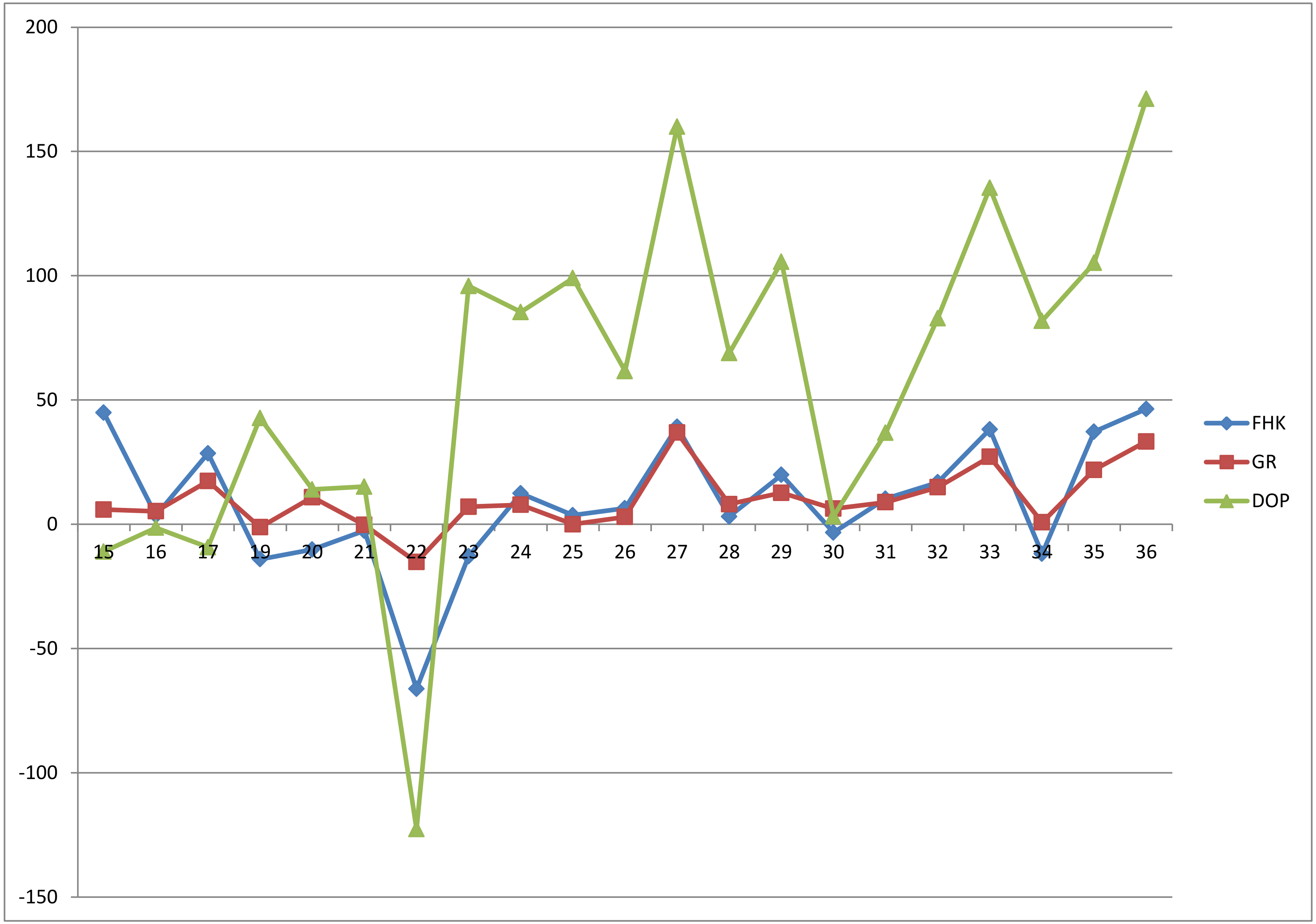
Figure 8: Within effects by industry: 2000-01 to 2005-06



Further, these effects seem to be more modest in the traditional sector than the high tech sector, if we use FHK and GR methodologies. Theoretically, retooling effects should be larger in technologically laggard industries where the escape entry should more likely to happen. Indian manufacturing poses an interesting where within effects are most visible in high tech industries. In this group however, office computing machinery industry (30) is an exception case with rather modest within-effect irrespective of the methodology used. This is despite the fact that it has experienced the highest productivity growth during this period. Over 99 percent of productivity growth in this industry has occurred due to expansion of sample sector plants which joined the census sector during this period. In publishing and printing industry also, entry effects are exceptionally large; within effects are therefore insignificant.

Reallocation effects: Reallocation effects as presented in figure 9 indicate that most manufacturing industries have been undergoing the process of restructuring from low productivity to high productivity plants. As expected, reallocation effects are rather large for the DOP decomposition. There are conflicting results as well. However, one can discern that reallocation process has initiated in medium and high tech industries but not in low tech traditional industries. In the last category of industries, entry effects are strong but within effects are relatively weak. It might take some time for the reallocation process to start taking shape.

Figure 9: Reallocation effects by industry: 2000-01 to 2005-06



Apparently, a fast growing economy like India manifests the patterns of both developed countries as well as transition countries. It also reveals interesting patterns regarding the impact of firm dynamics in low and high tech industries, which needs to be explored further.

9. Conclusion

In this paper, we use a plant panel data set of Indian manufacturing industries to examine productivity differences between groups of entering, exiting and continuing plants. To account for observed heterogeneous productivity, we rely on models of industry dynamics, which emerged after the seminal works of Jovanvic (1982) and Hopenhayn's (1992). Our empirical strategy is to use productivity decomposition methodologies provided in the literature. Our empirical study reveals some important results that are do not conform to the theoretical predictions and makes a case for such analyses for fast growing countries like India. The results can be summarized as follows.

- First, productivity increased substantially across all industries but there are wide differences in productivity across industries. Second, there is a clear evidence of creative destruction in the manufacturing sector. Third, the evidence presented indicates that the productivity growth of incumbent firms dominates the overall productivity growth. These patterns are consistent to market selection as predicted by Hopenhayn's (1992) model. Third, notwithstanding the fact the continuing firms dominate productivity growth, entry effects are also substantial. This is not quite consistent with Hopenhayn's but is more akin to Shumpeterian hypothesis. Nonetheless, the evidence we find indicates that these effects operate via growing entrants grows which exhibit high productivity that tends to reach the level of incumbent firms. This is more in line with Hopenhayn's theoretical predictions.

Fourth, we find entry effects relatively larger in low (and matured) and high tech industries. These are modest in medium tech industries. These results are not quite in conformity with the existing literature which predicts entry effects to be significant in only high tech industries. Fifth, within effects are large in all the industries but they grow stronger in high tech industries. This is also an interesting pattern which is not quite expected. Catching up process seems to be faster in high-tech industries. Finally, there is evidence of reallocation effect taking place in the economy, in particular, in medium and high tech industries.

In sum, entry effects are supported by within and reallocation effects in Indian manufacturing. In medium tech industries within effects are supported by reallocation effects; entry effects are modest. In low tech industries entry and within effects are relatively strong. In high tech industries all the three effects seem to reinforce restructuring. Thus the study supports the hypothesis that tremendous business dynamism is taking place in the economy.

There are two caveats. First, any productivity growth decomposition is only a statistical tool. It neither provides information about the driving forces behind the contributions of each component to productivity, nor takes into account the threat of entry. Hence, these tools do not give clues on the causality between entry/exit and productivity growth and the links in between (such as innovation). Second, there is a risk of underestimation of the entry effect on industry productivity growth as the decompositions fail to account for indirect effects of entry on the productivity of incumbents. As discussed in Section 4, the measured within and between plant effects could in part be due to entry. But this indirect effect of entry is not captured in these methodologies. In an analysis of Portugese manufacturing firms for 1996-2000, Carreira and Teixeira (2009) find that the indirect effect of entry is of greater magnitude than the direct one. We plan to explore the indirect effects in the second stage of this research. However the present analysis provides useful insights on the process of business dynamism taking place in the economy. This research thus calls for more research in this area.

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Appendix: National Industrial Classification 2004

15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	Manufacture of paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastics products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c.
30	Manufacture of office, accounting and computing machinery
31	Manufacture of electrical machinery and apparatus n.e.c.
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
36	Manufacture of furniture; manufacturing n.e.c.