Productivity gain through reallocation - lessons and early results from a recent project using ABS

Productivity User Group

Bob Butcher
with Matthew Bursnall (BIS) and Cinzia Rienzo (NIESR)

National Institute of Economic and Social Research
and Department for Business Innovation and Skills.

28 January 2014

Acknowledgements:
The financial support of the Economic and Social Research Council grant reference ES/K007416/1 is gratefully acknowledged.

Purpose of project

Overall

- To obtain greater impact on policy from existing findings on economic churn and from greater use of firm level data.

Specifics

- Explore the common finding in the literature that a large proportion of productivity gain is due to reallocation, especially entry of new firms, with a minority from improvement within firms
- Highlight the role of reallocation in policy and evaluation
- Increase access to the micro-data for policy purposes

Caveat

- These are initial findings from our project and may be substantially revised for the final version.

Key findings from the literature

- There is considerable dispersion in productivity levels between firms. Even in narrow subsectors it is usually the case that some firms have double the productivity (TFP) of others (Griffith Haskell Neely 2006, Syverson 2010
- There is also strong 'persistence' with firms tending to stay at about the same relative point over time in the distribution (Bartelsman Doms 2000)
- Entry and exit of firms makes a substantial contribution to productivity gain (Foster Haltiwanger Krizan (2001) – FHK)
- Disney et al (2003) find that only 48% of labour productivity arises from improvements within the firms, the rest from reallocation (entry, exit, expansion, contraction). For Total Factor Productivity (TFP), they find 95% of gain is due to reallocation

Note: There are different units of analysis – the workplace or Local Unit, the Reporting Unit (a group of workplaces), the Enterprise (a legal entity with self-determination), or Enterprise Group (a group of Enterprises under common ownership). When I use 'firm' this could mean any business unit

Issues

- Entry
- Cross term
- Logs
- Sampling and weighting

Decomposition - FHK

- The most widely used method is so-called FHK from the Foster Haltiwanger and Krizan paper of 2001.
- It estimates the *within* firm improvement by fixing the size of firms and measuring change in productivity.
- The *reallocation* or *between* firm component is estimated by fixing the initial productivity level and measuring the change in size. Note though that this is taken as a positive contribution if the productivity is above average or above a benchmark – usually the average productivity in time 1.
- The *exit* component is the productivity of the firm before exit minus the benchmark, ie average productivity at time 1. If this is negative the removal of the firm makes a positive contribution to overall productivity.
- The *entry* component is the productivity of the firm on entry minus the benchmark, usually still the time 1 average.

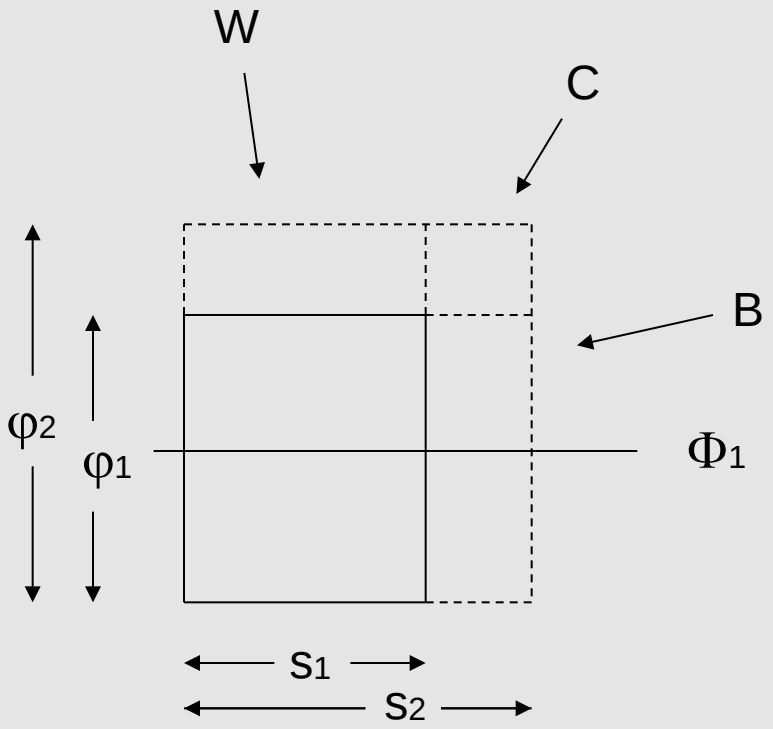
Example data from the literature - TFP

Table 1: Decomposition of TFP Growth for U.S. Manufacturing Establishments, Selected Periods

Census period	Total growth	Within-plant share	Between-plant share	Cross-plant share	Net entry share
1977 - 87	10.24	0.48	-0.08	0.34	0.26
1977 - 82	2.70	-.09	-0.33	1.16	0.25
1982 - 87	7.32	0.52	-0.18	0.51	0.14

Notes: Tabulations from LRD by Foster, Haltiwanger, and Krizan (1998).

The components for a continuing or surviving firm:



Entry and exit

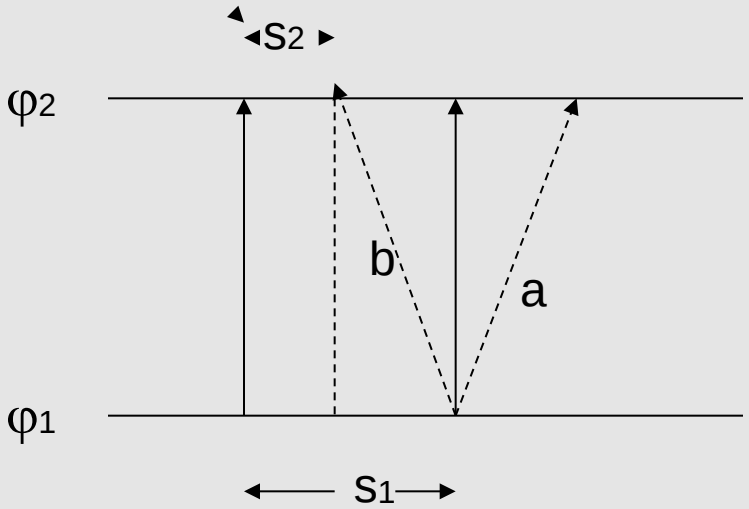
- In many studies, the analysis horizon is an extended period.
  - FHK used 5 year gaps – 1977-82, 82-87 and 87-92 – as the data were only collected every 5 years at the time.
  - Disney et al used a 12 year gap, 1980-92, presumably to reduce the work in using more than 2 years' worth of data.
- This raises two issues for the entry first component.
  - First a firm that sets up a year after time 1 will have several years of improvement or change within the firm and several years of reallocation confounded with the entry component.
  - Second in a period of growing productivity, comparing the entry firm's productivity with a benchmark at time 1 is likely to give a strong upward bias.
  - Sensitivity testing has not shown a major problem which presumably means the two effects have counter-balanced one another so far (Disney et al and Melitz et al).

Entry and exit

- We use just a single year horizon, and we use the FHK benchmark of year 1. We tested the alternative benchmark of year 2. See table 7. It made little difference, partly because in these analyses the entry and exit components are small.
- Probably using a year 1 benchmark as in FHK is acceptable.

Cross term

- The cross term in FHK is fine if it is small or negligible. However in very many studies the cross term is large and not easily interpreted.
- Sometimes it is put with the between term and called reallocation, which is not quite right as it is a mixture.
- It turns out to be improved when we take a consistent approach between expansion and entry.



The FHK 'within' term is $s_1 * (\varphi_2 - \varphi_1)$

That is ok if expanding (a), but less correct if contracting (b). We then use the end size s_2 for the amended within term, which happens to be FHK within plus cross.

The extra resource when expanding we think should be treated like the entry term, and compared with the overall average at time 1, Φ_1, which happens to give the between plus cross term.

Logs

Logs v natural figures

Financial data are better when logged as skew is reduced, and some high outliers are moderated.

However, we need to handle negative gva

We did not want to remove firms with negative gva (as some authors do) since they are important part of story (especially in downturn)

We experimented with adding a shift parameter to values before logging, but our tests using positive gva values produced quite different relationships between components using a log analysis with shift than the natural analysis. We decided to keep with the natural analysis.

Weighting

- We weighted the subsample of firms (Reporting Units) that were in both years of a pair, controlling for four separate variables – employment in years 1 and 2, and gva (market prices) in years 1 and 2.
- It took some time to get this right, and we used an adaptation of iterative proportional fitting, rather than exact arithmetic.

Other details

- Deflators – we used gdp deflators within 2 digit sectors for Sic 07
- Sector – we converted all sic92 codes to sic07 using the ONS matching table, interpolating where needed using employment as the determining factor when needed
- We removed sectors for which the ABS or ARD do not have satisfactory data, either missing, subject to substantial subsidy, or dominated by the public sector. The omitted sectors include sic 07 sectors A-B, K, O-Q, U [further details in the paper]

Decomposition

Overall labour productivity at time 1 can be written as

$$\Phi_1 = \sum_{i \in X} s_{i1} \varphi_{i1}$$

Productivity gain between time 1 and time 2 can be written

$$\Phi_2 - \Phi_1 = W + B + C + En - Ex$$

Decomposition (2)

Productivity gain = $\Phi_2 - \Phi_1 = W + B + C + En - Ex$ where

within term

$$W = \sum_{i \in S} s_{i1} (\varphi_{i2} - \varphi_{i1})$$

between term

$$B = \sum_{i \in S} (s_{i2} - s_{i1}) (\varphi_{i1} - \Phi_1)$$

cross term

$$C = \sum_{i \in S} ((s_{i2} - s_{i1}) (\varphi_{i2} - \varphi_{i1})$$

entry term

$$En = \sum_{i \in E} s_{i2} (\varphi_{i2} - \Phi_1) = S_{E2}(\Phi_{E2} - \Phi_1)$$

exit term

$$Ex = \sum_{i \in X} s_{i1} (\varphi_{i1} - \Phi_1) = S_{X1}(\Phi_{X1} - \Phi_1)$$

Early results

Caveat: There has been considerable checking of process, but little checking of plausibility and meaning as yet. We are happy to receive comment and suggestions for improvement, but please do not quote as our final view. Having said that, the findings do generally agree with what others are finding eg IFS and other work in NIESR.

Table 1. Trend in labour productivity and decomposition

	Labour prod'y	% increase	FHK decomposition				
			Within	Between	Cross	Entry	Exit (neg)
2003	*35.6*	-					
2004	37.7	5.9	8.7	2.8	-6.5	0.6	0.3
2005	38.8	3.0	4.5	4.3	-6.4	-0.8	1.4
2006	39.6	2.0	1.6	7.1	-7.7	-1.1	2.1
2007	42.1	6.3	8.5	14.5	-15.9	-0.7	0.0
2008	41.1	-2.4	-1.0	-1.0	-0.8	-0.2	0.6
2009	37.7	-8.2	-7.5	6.6	-7.6	-1.6	1.9
2010	39.8	5.6	7.4	3.6	-5.0	-0.8	0.4
2011	39.9	0.1	1.1	1.7	-3.2	-0.9	1.5
Av 04-07		4.3	5.8	7.2	-9.1	-0.5	0.9
Av 08-11		-1.2	0.0	2.7	-4.1	-0.9	1.1

Table 2 Components using 'amended FHK'

		FHK-amended			
	% increase	Within	Between	Entry	Exit (neg)
2004	5.9	5.1	-0.1	0.6	0.3
2005	3.0	2.1	0.3	-0.8	1.4
2006	2.0	-0.8	1.9	-1.1	2.1
2007	6.3	6.0	1.1	-0.7	0.0
2008	-2.4	-2.4	-0.3	-0.2	0.6
2009	-8.2	-8.1	-0.4	-1.6	1.9
2010	5.6	5.5	0.5	-0.8	0.4
2011	0.1	-0.3	-0.1	-0.9	1.5
Ave 04-07	4.3	3.1	0.8	-0.5	0.9
Ave 08-11	-1.2	-1.3	-0.1	-0.9	1.1

Table 3 Contribution to productivity gain by improving vs declining firms

	% increase	FHK Decomposition					
		Improving (in prod'y)			Declining		
		Within	Between	Cross	Within	Between	Cross
2003	-						
2004	5.9	22.1	0.5	-3.4	-13.4	2.3	-3.1
2005	3.0	18.8	1.3	-2.3	-14.3	3.0	-4.0
2006	2.0	19.5	1.5	-2.0	-17.8	5.6	-5.7
2007	6.3	23.2	0.7	-2.2	-14.7	13.7	-13.7
2008	-2.4	18.8	-3.4	1.6	-19.8	2.4	-2.3
2009	-8.2	15.1	-0.1	-0.9	-22.6	6.7	-6.7
2010	5.6	22.1	0.5	-1.7	-14.7	3.1	-3.3
2011	0.1	17.5	0.4	-1.5	-16.4	1.3	-1.7
Ave 04-07	4.3	20.9	1.0	-2.5	-15.1	6.2	-6.6
Ave 08-11	-1.2	18.4	-0.6	-0.6	-18.4	3.4	-3.5

Table 4 Contribution to productivity gain by expanding and contracting firms

FHK Decomposition		FHK Decomposition					
		Expanding (in empt)			Contracting		
	% increase	Within	Between	Cross	Within	Between	Cross
2004	5.9	-2.8	1.2	-2.9	11.5	1.6	-3.6
2005	3.0	-3.4	2.7	-4.0	7.9	1.6	-2.4
2006	2.0	-4.7	5.1	-5.2	6.3	2.0	-2.5
2007	6.3	-1.1	13.2	-13.4	9.6	1.3	-2.5
2008	-2.4	-5.8	-2.6	0.6	4.8	1.6	-1.4
2009	-8.2	-4.9	5.5	-7.0	-2.6	1.1	-0.6
2010	5.6	-2.6	2.7	-3.1	10.0	0.9	-1.9
2011	0.1	-3.6	1.0	-1.8	4.6	0.6	-1.4
Ave 04-07	4.3	-3.0	5.5	-6.4	8.8	1.6	-2.7
Ave 08-11	-1.2	-4.2	1.7	-2.8	4.2	1.1	-1.3

Table 5 - Alternative counterfactual at time 2

	Entry	Exit (neg)	Ent-2	Exit-2
Ave 04-07	-0.5	0.9	-0.7	1.1
Ave 08-11	-0.9	1.1	-0.8	1.0

Table 6 - by size band. [needs further checking]

Employment			FHK-amended			
		% incr'se	Within	Between	Entry	Exit (neg)
1-49	ave04-07	3.6	1.6	1.7	-2.4	2.7
	ave 08-11	-0.3	-0.8	0.6	-2.9	2.8
50-249	ave04-07	0.9	1.4	-0.7	-0.1	0.4
	ave 08-11	-3.0	-2.9	0.0	-0.4	0.3
250+	ave04-07	10.3	8.0	1.5	2.1	-1.2
	ave 08-11	-1.1	-0.8	-1.1	1.5	-0.7
Total	ave04-07	4.3	3.1	0.8	-0.5	0.9
	ave 08-11	-1.2	-1.3	-0.1	-0.9	1.1

Table 7 Components using Melitz and Polanec

		MP decomposition			
	% increase	Within	Between	Entry	Exit (neg)
2004	5.9	9.1	-3.9	0.5	0.2
2005	3.0	2.4	0.2	-0.8	1.2
2006	2.0	2.1	-0.8	-1.0	1.8
2007	6.3	5.6	1.8	-1.0	-0.1
2008	-2.4	5.3	-8.4	0.2	0.5
2009	-8.2	-12.6	3.8	-1.3	2.0
2010	5.6	-2.9	9.1	-0.9	0.4
2011	0.1	-2.8	2.4	-1.2	1.8
Ave 04-07	4.3	4.8	-0.7	-0.6	0.8
Ave 08-11	-1.2	-3.3	1.7	-0.8	1.2

Conclusions

- The literature shows the importance of reallocation to productivity gain, although these recent data from the UK show rather less than previously.
- Policy aimed at productivity gain will be stronger if it can take account of economic churn, including for example policy on skills and employment.
- Evaluation in particular should aim to include the impact of policy on the reallocation process.
- It will help if the UK firm level data could include both financial and employment data if only light touch versions, in the same dataset, ie for the same firms.
- Within Government, improved documentation, and sharing of common code, will aid ad hoc access and greater use of these valuable data.

References

- Disney, Haskell, Heyden (2003)
- Foster, Haltiwanger, Krizan (2001)
- Melitz and Polanec (2012)
- Syverson (2010), “What determines productivity?”
- Bartelsman Doms (2000)
- Griffith Haskel Neely (2006), “Why is productivity so dispersed?”

Disclaimer

Any views expressed cannot be taken to represent those of the Department for Business Innovation and Skills or NIESR.

This work contains statistical data which is Crown Copyright; it has been made available by the Office for National Statistics (ONS) and has been used by permission. ONS do not bear any responsibility for the analysis or interpretation of the data reported here. This work uses research datasets which may not exactly reproduce National Statistics aggregates.