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DO TRAINING LEVIES WORK?

Malaysia's HRDF and Its Effects on Training and Firm-Level Productivity[1]

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[1] [1] This paper draws upon the 1997 World Bank Country Study, "Malaysia: Enterprise Training, Technology and Productivity", and a 2000 PSD Report to the Economic Planning Unit, Prime Minister's Department, "Technology and Skill Needs in Malaysian Manufacturing".

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ABSTRACT

Many developing countries have put in place a variety of policies to foster in-service training among its enterprises, despite only limited and mixed evidence that such policies actually work. This paper examines Malaysia's experience with a training pay-roll levy scheme—the Human Resource Development Fund (HRDF)—that has been in place since 1993. Using unique panel data on firms and their training practices both before and after HRDF was introduced, I investigate the effect that enactment of HRDF had on promoting the incidence of enterprise training among different groups of firms, and over time, isolating the HRDF effects from that of contemporaneous forces that also influence training, in particular, adoption of new technology. The results suggest that the training incentive from HRDF was more important than technological change, especially among medium size firms, while adoption of new technology had the most pronounced training effect among small firms. I also find evidence that training raises firm-level productivity growth, that these productivity effects are enhanced with continuous training and when training is accompanied by introduction of new technology.

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I. INTRODUCTION

Many countries, both advanced and developing, have put in place different policies designed to promote in-service training among its enterprises, and through upgrading workforce skills, to foster technological change and raise the productivity and competitiveness of firms. These employer-targeted training policies take many forms: training levy-grant schemes such as those used in Singapore and previously in the United Kingdom, where fund administrators use levies to make grants to employers for approved training; training levy rebate schemes of Malaysia, Nigeria and the Netherlands, where employers are partially reimbursed for approved training out of their payroll levies; levy exemption schemes such as those used in France and Korea where employers are exempt from levy payments provided they spend a given percentage of their payroll on training; and tax incentives for approved training funded from general revenues, as in Chile and previously in Malaysia.

How well have these training policies worked in promoting in-service training? The evidence is mixed.[2] In spite of the prevalence of training levy schemes, there have been few rigorous evaluations of the effectiveness of these policies. The scattered evidence suggests that while they generally had a positive impact on increasing in-service training, they have tended to be inequitable–large employers have benefited to a greater extent than small or medium-size employers. Problems associated with administering the fund and problems of non-compliance abound, especially with training schemes in many developing countries. Even more uncommon are studies of the impact that enactment of such training policies have had on desired policy outcomes, such as firm-level productivity growth.

[2] See the review of training levies by Amit Dar, Sudarshan Canagarajah and Paud Murphy, "Training Levies: Rationale and Evidence from Evaluations", The World Bank, November 2000.

This paper examines Malaysia's experience with the Human Resource Development Fund (HRDF), a training levy-rebate scheme that has been in place since 1993. It uses unique panel data on manufacturing firms and both their training practices and technological activities before and after HRDF was introduced to: (1) evaluate the impact that enactment of HRDF had on promoting enterprise training, among different groups of firms, and over time; (2) disentangle the training effects of HRDF from that of contemporaneous forces that also influence training, in particular, adoption of new technology; and (3) estimate the impact of training on firm-level productivity growth, for different groups of firms varying in technological effort and in whether they trained episodically or continuously.[3]

To address these issues, the paper exploits the availability of three large enterprise surveys conducted in 1988, 1994 and 1997 that were linked, not only to each other, but also to panel establishment-level data covering the period between 1985 and 1996.[4] These data have several key features. First, the enterprise surveys elicited broadly similar data on training and use of new technology, which allows incidence of training to be documented both pre- and post-1993 when HRDF was enacted, and the training effects of HRDF to be isolated from those of contemporaneous investments in new technology that also raise skills and training requirements.[5] Second, the 1994 and 1997 surveys asked whether eligible firms (with over 50 employees) were registered with the HRDF. The fact that registered firms have incentives to train so as to recover their payroll levy contributions, while non-registered firms do not, is exploited to disentangle the incentive effects of HRDF from that of technological change in the post-1993 period. Finally,

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[3] The distinction between one-off training and continuous training is important since one objective of HRDF is to systematize and instill a training culture among enterprises.

[4] These links were possible because each survey—the 1988 Labor Market Flexibility Survey (LMFS), the 1994 Malaysia Industrial Training and Productivity Survey (MITP), and the 1997 Inter-Firm Linkages and Technology Development Survey (ILTD)—drew upon the manufacturing sector sampling frame of the national statistical office (DOS), which in turn provided linked establishment files from annual surveys of manufacturing.

[5] In addition to training incidence, all three surveys also asked about training intensity—the proportion of the workforce that was trained. However, as Section II explains, training questions were framed slightly differently in the 1988 survey as compared to subsequent surveys, making it difficult to define training incidence consistently over time, let alone a training intensity measure. As such, the paper focuses only on training incidence.

linking the three enterprise surveys to annual manufacturing survey data—which contain detailed production input and output information—brings together training and productivity information, which permits estimation of production functions to measure the effects of training (and indirectly of HRDF) on productivity growth.

Section II begins by providing some background on the HRDF and its different training schemes. The three enterprise surveys are then used to characterize broad trends in enterprise training between 1988 and 1997, by industry and firm size, and by whether firms were registered with the HRDF or had recently adopted new technology. Section III reports regression results on the determinants of training over the 1988-1997 period. It then uses these results to simulate what training incidence would have been under different scenarios, to get insights into the relative importance of HRDF and technological change in fostering training among different groups of firms. Section IV turns to the productivity outcomes of training, reporting panel production function estimates of the productivity impact of enterprise training. Section V concludes with summary remarks.

II. OVERVIEW OF HRDF AND TRAINING TRENDS

The HRDF was established in 1993 with a matching grant from the Government.[6] It replaced the training tax incentive scheme (the double deduction incentive for training) that had been in operation since 1987, and which was widely acknowledged to have been ineffective.[7] The Act created a council (HRDC), with representatives from the private sector and from responsible government agencies, and a Secretariat to administer the HRDF schemes. Eligible employers with 50 employees and above were required to contribute 1 percent of payroll to the HRDF. Those who had contributed a minimum of six months were then eligible to claim a portion of allowable training expenditures up to the limit of their total levy payments for any given year. The HRDC set rates of reimbursement, varying by type of training and generally lower for larger firms.

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[6] The Government contributed R48.9 million to match projected company levies in the first year; in each of the following three years, it will add an additional R16.3 million to the HRDF.

[7] See Tan and Gill (2000) for an expanded discussion of training policies in Malaysia.

In 1993, the HRDC introduced three basic training schemes that offered firms considerable flexibility over their training programs. In the ATP scheme, employers can freely send employees for approved training courses offered by registered training providers without the prior approval of the HRDC, and submit claims on completion of the course. In the SBL scheme, employers submit plans to HRDC for approval of *ad hoc* in-plant or external training courses offered by non-registered training providers. These plans must include specific objectives, areas of training, duration, number of trainees, instructors, and means of assessment. In the PLT scheme, which is designed for firms with long-term and predictable training needs, employers submit detailed annual training plans covering at least 10 percent of the company's workforce and 15 percent of junior level employees. In addition, HRDC supported efforts of employers to develop training plans through the JURUPLAN scheme.

In 1995-1997, the HRDC introduced several additional schemes, many with a focus on the needs of small and medium-size enterprises (SMEs) that did not appear to respond well to these training incentives. The PERLA Scheme was designed to lower upfront training cash outlays for SMEs by enlisting ATP training providers as HRDC agents, to collect from users only that portion of fees for which firms were responsible and claiming the reimbursable balance directly from HRDC. The HRDC also targeted SMEs with Training Needs Analysis (TNA) workshops and clinics to answer questions about different schemes, and provided them with financial assistance for the purchase of training aids and equipment. More recently, it also introduced other schemes to promote group-based and low-cost training for SMEs, and incentives for SME employer associations to develop training programs tailored to their members' needs.

Time Trends in Incidence of Enterprise Training

Did enactment of HRDF in 1993 have any impact on promoting in-service training among enterprises? To address this question, I use three enterprise surveys fielded in 1988, 1994 and 1997 that elicited broadly similar information on training practices. They provide snap-shots of enterprise training at three points in time—in 1988 prior to HRDF, in 1994 a year or so after HRDF was enacted, and in 1997 or 3 years later. The analysis is restricted to sub-samples of the three surveys that can be linked to the panel establishment data from the Industrial Survey.[8]

Creating a consistent measure of training over time involved several assumptions. First, I focus only on formal training. Both 1994 and 1997 surveys distinguished between formal training—with theory and class-room instruction coupled with on-the-job training—provided either in-house or by external training institutions, and informal training, which is provided by co-workers and supervisors. Informal on-the-job training is excluded because it is poorly recalled and, in any case, is not eligible for training levy rebates.[9] Second, and unlike the other surveys, the 1988 survey asked employers about the main form of training, whether from informal training, formal training on-the-job, formal training in external institutions, or "other" unspecified training source. By this yard-stick, only 13.3 percent of companies in 1988 provided formal training as the main training modality in 1988. If we assume that all training modalities include some element of formal training, then 34.1 percent of firms reported some "formal" training. In the balance of this paper, I rely on this expanded definition of formal training for 1988.[10]

The first panel of Table 1 shows the industry and firm size distribution of the three surveys, based on a total sample of 2,308 observations in 1988, 2,090 observations in 1994, and 1,653 observations in 1997. The second panel shows the percent of firms that reported providing formal training in each year. Keeping in mind the definition of formal training, note the dramatic rise over time in the incidence of training—from 34.1 percent in 1988 to 40.6 percent in 1994 and to 51.7 percent by 1997. Some small part of

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[8] This ensures that the trend analysis and the subsequent production function estimation are done on the same data sets.

[9] This is not a critical omission here, or for the subsequent production function analysis since there is evidence from other research that the productivity impact of informal training is rarely discernible. See World Bank (1997), Malaysia: Enterprise Training, Technology and Productivity.

[10] This training definition overstates the incidence of formal training in 1988 since not all firms that rely on the informal modality also provide formal training. But to the extent that this assumption biases down level differences in training incidence between 1988 (pre-HRDF) and 1994 and 1997 (post-HRDF), it also strengthens the subsequent findings that enactment of HRDF increased enterprise training.

this secular change is attributable to subtle changes in sample composition, in particular a higher fraction of small firms in the 1988 sample who, in general, are less likely to train. Even still, a similar rising trend in training is observed separately by industry and firm size. It is noteworthy that the incidence of training rises with firm size, and in those industries thought to be "high-tech" such as electrical machinery, transportation equipment, chemicals and petroleum products as compared to "low-tech" industries such as food, textiles and wood products.

Table 1 Sample Size and Percent of Firms
Providing Formal Training by Industry and Firm Size—1988, 1994, 1997

	Number of Observations			Percent Formal Training		
Industry	1988	1994	1997	1988	1994	1997
Food & Beverages	518	399	308	26.2	28.6	39.6
Textiles & Apparel	199	209	174	38.7	34.5	48.3
Wood & Wood Products	234	219	151	20.1	30.1	36.4
Furniture	68	69	76	29.4	26.1	39.5
Paper & Printing	150	126	119	39.3	34.9	52.9
Chemicals & Petroleum	383	339	254	41.0	50.1	65.3
Glass & Ceramics	143	129	95	25.9	44.2	47.4
Basic Metals	71	57	46	29.6	45.6	60.9
Fabricated Metals	141	116	104	39.0	40.5	48.1
General Machinery	121	87	78	28.9	34.5	43.6
Electrical Machinery	138	208	136	63.0	64.4	84.6
Transport Equipment	78	74	47	42.3	50.0	63.8
Other Industry n.e.c.	64	58	65	37.5	58.6	50.8
Firm Size						
Small—Less than 100	1,614	1,159	894	24.3	25.5	35.1
Medium—100-249	433	535	437	49.9	51.8	63.6
Large—250+	261	396	322	68.6	69.7	81.7
Total	2,308	2,090	1,653	34.1	40.6	51.7

Source: 1988 LMF, 1994 MITP and 1997 ILTD surveys.

Was the 1993 enactment of the HRDF responsible for this rising trend in training? To address this hypothesis, recall that HRDF was designed to change employers' incentives to train by making it mandatory for firms with 50 or more workers to contribute a training levy of 1 percent to the HRDF, levies that are partially reimbursed to employers upon provision of approved training programs. As such, I restrict analysis in all three years to firms with 50 or more employers, the "eligible" sample of firms required to register with the HRDF. However, post-1993, not all eligible firms registered with the HRDF, [11] and only those firms that did (and were presumably paying the training levy) may have faced greater incentives to train. Thus, for the 1994 and 1997 samples, I further distinguish between firms by whether they reported being registered with HRDF.

Table 2 Percent of Firms Providing Formal Training
by Firm Size and Status of HRDF Registration—1988, 1994, and 1997

Firm Size	1988	1994	1997	1994		1997	
				HRDF=0	HRDF=1	HRDF=0	HRDF=1
Small	35.03	39.44	49.10	32.49	46.43	34.54	63.31
Medium	49.88	51.77	63.62	37.06	57.14	33.88	75.00
Large	68.58	69.70	81.68	44.00	71.43	34.21	88.03
Total	47.23	53.47	64.50	35.07	60.48	34.26	77.24

Note: HRDF = 1 indicates registration with the HRDF and payment of training levies, while HRDF = 0 indicates not-registered with HRDF.

Table 2 incorporates both refinements. The first panel shows a higher proportion of eligible firms reporting training in each year, as might be expected once small firms with fewer than 50 employees are excluded. The rising trend in training is still apparent, with training incidence rising from 47.2 percent in 1988 to 53.5 percent in 1994, and to 64.5 percent in 1997. The second panel shows training incidence in 1994 and 1997, separately by HRDF registration status. In each year, and for each firm size category, training incidence is dramatically higher for firms registered with HRDF. For example, in 1994, 60 percent of registered firms trained as compared to 35 percent of non-registered firms; by 1997, the corresponding figures were 77 percent and 34 percent, respectively. Similar trends are found in the balanced panel of firms.[12] Together, these results lend some support to the view that enactment of HRDF in 1993 was important in fostering training among employers.

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[11] About 75 percent of eligible firms in 1994 and 1997 reported that they were registered with the HRDF.

[12] The results are virtually identical for tabulations using the balanced panel of 646 firms that appear in all three surveys. In 1994, 60 percent of registered firms reported training as compared to 31 percent of non-registered firms; the corresponding figures in 1997 were 73 and 33 percent, respectively.

But some part of this training trend may also be attributed to technological change. There is a growing body of literature in both advanced and developing countries that skill-biased technological change creates increased demand for skilled workers and for training to use the new technology.[13] Diffusion of information and communication technologies (IT) in the 1990s may also have contributed to the rising demand for skilled and trained workers.[14] We examine this possibility using direct firm-level measures of technology use. The first measure, common to all three surveys, is an indicator variable for whether the firm introduced new product or process technologies over the past two to three years. About 30.9 percent of firms in 1988 reported having introduced new technology over the recent past; the corresponding figures for 1994 and 1997 were 42.6 percent and 28.5 percent, respectively. The second is an indicator variable for whether the firm is currently using one of five types of IT in its production processes.[15] This measure was only elicited in the 1997 survey but, because date of technology adoption is known, this information can be tracked back over time and linked to firms in the two previous surveys. The proportion of IT-using firms in 1988 is relatively low—2.2 percent—but it rises to 8.1 percent by 1994, and to 20.6 percent by 1997.

Table 3 shows the incidence of training by use of new technology (TEC), separately by year and by firm size. First, consider Panel A. In each year, the likelihood of training is significantly greater in the sample that reported introducing new technology in the recent past as compared to those that did not—53.4 versus 25.5 percent in 1988, 58.3 versus 27.5 percent in 1994, and 75.4 versus 42.3 percent in 1997. In Panel B, the IT adoption variable in 1988 does a poor job discriminating between training and non-training firms, not surprising since IT diffusion was relatively low in 1988. In the more recent period, differences begin to emerge—70.4 versus 38.0 percent in 1994, and 82.9

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[13] See Berman Bound and Machin (1997), and World Bank (1997).

[14] See Bresnahan, Brynjolfsson and Hitt (1999), and Tan (2000).

[15] These five types of process IT include CAM (computer-assisted manufacturing), robots, CNC (computerized numerical control) machine tools, FMS (flexible manufacturing systems), and CIM (computer-integrated manufacturing).

versus 43.6 percent in 1997—as IT became more widely diffused. In tables not reported here, increased propensity to train with new technology is evident even in contingency tables further disaggregated by HRDF registration status post-1993.[16]

Table 3 Percent of Firms Providing Formal Training
by Firm Size and Type of New Technology Used—1988, 1994, and 1997

Firm Size	1988		1994		1997	
	TEC=0	TEC=1	TEC=0	TEC=1	TEC=0	TEC=1
A. New technology						
Small	19.49	41.34	18.25	42.53	29.22	61.21
Medium	43.44	58.20	41.18	62.74	57.29	75.00
Large	59.57	73.65	59.83	73.83	73.25	91.33
Total	25.52	53.36	27.50	58.31	42.30	75.37
B. Process IT						
Small	24.36	22.22	24.51	51.11	31.58	64.58
Medium	49.88	50.00	48.75	78.18	57.44	84.16
Large	68.46	70.00	68.19	76.81	71.51	94.41
Total	33.81	48.08	38.00	70.41	43.64	82.94

Note: TEC equals 0 or 1 indicates use of each type of new technology, where:
A. New technology = introduction of new product/process technology in previous 2-3 years
B. Process IT = use of one or more of 5 types of IT for production process functions.

III. EXPLAINING CHANGES IN TRAINING (1988-1997)

The contingency tables suggest that both HRDF enactment and use of new technology by employers contributed to rising training incidence over time. The issue is which determinant of training was quantitatively more important, and were they equally important for all firms? To rigorously test the relative efficacy of these two hypotheses, I estimate a multivariate regression model to measure their effects on training propensity over time, controlling for a variety of other factors.

The underlying economic model is one in which a firm's decision to train its employees is shaped by the profitability of this investment—the discounted future stream

[16] For example, in the sample not using advanced process IT in 1997, 45.5 percent of firms registered with the HRDF train as compared to 25.6 percent of non-registered firms; in the sample using advanced process IT, 90.7 percent of the sample registered with the HRDF train as compared to 47.5 percent that are not registered with the HRDF.

of productivity increases net of the cost of upgrading worker skills. The firm trains if the net present value of training is positive; otherwise, it does not. HRDF creates training incentives on the cost side. By reimbursing employers for part of the costs of approved training from mandatory payroll levies, HRDF in effect lowers the cost of training to employers. In contrast, technological change creates incentives to train on the revenue side. If new technology requires inputs from skilled workers to fully realize its productivity potential, its adoption can be a powerful incentive for employers to initiate training in anticipation of a higher revenue stream from increased productivity growth.

The analytic framework is a random-effects probit model of a firm's training decision, which can be written as follows:

$$P_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Y_i + \beta_3 Z_t + \varepsilon_{it}$$

where the dependent variable, P_{it}, takes on a value of 1 if firm i provides training in year t, and 0 otherwise. The probability of training, P_{it}, depends on its profitability, and I assume that this is reflected in a vector of time-varying variables X_{it}—highly skilled workers (professionals, managers, and technicians) and skilled production workers as a proportion of the workforce; union status; whether registered with HRDF; use of new technology, TEC; exporting status; and dummy variables for medium and large firms. The vector Y_i refers to dummy variables for 12 sectors (assumed to be time-invariant); Z_t refers to year dummy variables for 1994 and 1997, with 1988 as the (omitted) base year; and β's are parameters to be estimated.[17]

Table 4 reports probit estimates for model specifications corresponding to the two technology measures. Consistent with previous tabulations, the probit results indicate that both enactment of HRDF in 1993 and use of new technology TEC contributed to rising incidence of training over time. Controlling for other factors, both HRDF registration and TEC—whether measured by recent adoption of new technology or by use of IT—are positively related to training propensity at the 1 percent level of statistical

[17] In addition, indicator variables for missing values were included for union status, skill composition, and IT use, the latter being available only for those firms that can be linked to the 1997 ILTD survey.

significance. As before, training propensity is higher in medium and large firms as compared to small firms, suggesting that training is more profitable in larger firms. Training propensity is also positively associated with the share of the workforce that is highly skilled, reflecting the greater ability of more educated workers to benefit from training, and to use new technology.[18] However, this result does not extend to skilled production workers, which is not a statistically significant. Finally, the results indicate that unionized and export-oriented firms are more likely to train.

Table 4 Random Effects Probit Estimates
Probability of Formal Training—1988, 1994, and 1997

Dep. variable: $P(train)_{it}$	Model 1		Model 2	
Explanatory variables:	Coefficient	z-statistic	Coefficient	z-statistic
Introduced new technology	0.5555	12.74	--	--
Use advanced process IT	--	--	0.4839	6.14
Registered with HRDF	0.6346	11.15	0.6111	10.78
Medium size firm	0.4094	7.71	0.4555	8.62
Large size firm	0.7386	10.57	0.8271	11.88
Proportion highly skilled	1.0244	7.49	0.9906	7.26
Proportion skilled production	-0.0046	-0.06	-0.0258	-0.35
Union indicator variable	0.3102	5.87	0.3140	5.97
Export indicator variable	0.1521	3.31	0.2223	4.88
1994 indicator variable	-0.2675	-4.90	-0.2138	-3.90
1997 indicator variable	0.1837	3.14	0.1199	1.86
Constant term	-1.0995	-8.52	-0.9976	-7.63
Log-likelihood	-3281.7		-3347.8	
Total number of observations	6,052		6,052	
Total number of firms	3,703		3,703	

Note: Model includes missing indicator variables for IT, skills, and union status, as well as indicator variables for 12 industrial sectors

How well does the probit model explain changes in training propensity over time? In Table 5, we report actual probabilities of training (**in bold**) for each firm size category and year, and for comparison, probabilities predicted by the first specification of the

[18] See Bartel and Lichtenberg (1987). Tan and Batra (1995) find evidence for this finding in a broad range of developing countries.

probit model.[19] Note that the model tends to under-predict levels and the rise over time of training for small firms. Compared to actual training probabilities—35, 39 and 49 percent in 1988, 1994 and 1997—the predicted training probabilities are 24, 22, and 34 percent, respectively. For medium and large firms, the probit model does a better job predicting both training levels and the rise in training incidence over time.

Table 5 Actual and Predicted Probabilities of Training
And Simulations With HRDF and TEC—1988, 1994, and 1997

Simulations	Actual and Predicted Training			Percent Change from Baseline			Change as % of Baseline		
Firm size	1988	1994	1997	1988	1994	1997	1988	1994	1997
Small size Firms	**35.0**	**39.4**	**49.1**						
Predicted baseline	24.2	22.2	34.2	24.2	22.2	34.2	100	100	100
HRDF=0	24.2	16.9	28.2	0.0	5.2	6.0	0	23	17
TEC=0	20.1	17.2	30.5	4.1	5.0	3.7	17	22	11
Medium size firms	**49.9**	**51.8**	**63.6**						
Predicted baseline	47.1	53.1	65.9	47.1	53.1	65.9	100	100	100
HRDF=0	47.1	36.3	50.3	0.0	16.8	15.3	0	32	23
TEC=0	37.9	43.5	59.9	9.2	9.6	6.1	19	18	9
Large size firms	**68.6**	**69.7**	**81.7**						
Predicted baseline	65.2	74.8	82.0	65.2	74.8	82.0	100	100	100
HRDF=0	65.2	55.1	66.7	0.0	19.7	15.3	0	26	19
TEC=0	52.4	62.8	76.5	12.8	12.0	5.5	20	16	7

Note: 1. Simulations based upon probit parameters reported in Table 4.
2. Actual probabilities of formal training shown in bold.
3. For definitions of HRDF and TEC, see notes to Tables 2 and 3.

Table 5 also provides insights into the relative importance of the two competing hypotheses—HRDF and TEC—in shaping these training trends. Using the β parameters estimated by the probit model and keeping the values of all other variables the same, I simulate what training propensities would have been if either HRDF or TEC were set to zero. The first counter-factual—no firms are registered with the HRDF—is tantamount to assuming that HRDF was not enacted in 1993. The second counter-factual—no firms

[19] We focus on the results from the first model specification (recent adoption of new technology) since the simulation results of both model specifications are broadly similar.

introduce new technology—essentially assumes away technological change. The second panel of Table 5 shows the predicted change (decline) in training incidence under each scenario. In 1988, for example, setting HRDF = 0 does not change predicted training since this is a pre-HRDF year. Thus, in the second panel, the predicted change in the HRDF=0 row is also 0. But setting TEC = 0 in 1988 has an impact on predicted training, reducing training incidence for small, medium and large firms by 4.1, 9.2 and 12.8 percentage points, respectively.

Post-1993, the simulations indicate that enactment of HRDF had a more important impact on training than new technology. Compare the changes in training incidence predicted under the no-HRDF and no-technical change scenarios. In both years and for all firm sizes, the changes attributable to HRDF are always larger than those due to technical change. The exception are small firms in 1994 where the changes due to HRDF and TEC are roughly similar—about 5 percentage points. In all other cases, the differential impacts of HRDF and TEC on training are quite pronounced. In 1997, for example, the relative magnitude of HRDF and TEC effects among small firms were 6.0 and 3.7 percentage points, respectively; for large firms, the corresponding figures were 15.3 and 5.5 percentage points. In other words, enactment of HRDF in 1993 had a larger overall impact on training decisions than did the derived demand for training from technological change.

HRDF and TEC also affected training differently over the size distribution of firms. The third panel of Table 5 reports, by firm size, changes in training from HRDF and TEC measured as a percent of the baseline probability. It makes two points. First, the impact of HRDF on training is most pronounced for medium firms. Relative to the baseline, the no-HRDF scenario in 1994 is associated with a 32 percent change for medium size firms, larger than those for either small firms (23 percent) or large firms (26 percent); a similar pattern holds for 1997. One plausible explanation is that many medium size firms were close to the training threshold, and HRDF reduced the effective cost of training enough to tilt the calculus in favor of initiating training. HRDF was less effective for large firms, many of whom would have trained even in the absence of HRDF, and for small firms perhaps because their skill needs were less pressing.[20]

Second, the impact of technical change is greatest among small firms. Relative to the baseline, the no-TEC scenario is associated with the greatest impact—22 percent—for small firms, as compared to 18 percent for medium firms and 16 percent for large firms, a result that is repeated for 1997. This differential impact of TEC by size may simply reflect underlying differences in their technological sophistication. Many larger firms may already have in place modern equipment and trained personnel to use them, so introduction of new technology in the recent past has a smaller training effect, at least in the sense of initiating training. However, for small firms reliant on relatively mature technologies with low skill needs, the introduction of a new technology is more likely to create demand for new kinds of skills different from existing ones, and for training programs to supply these new skills.

IV. TRAINING AND PRODUCTIVITY GROWTH

The findings reported above are broadly consistent with the view that employer decisions about training are shaped by a rational calculus of the benefits and costs of training. Implicit in this view is the assumption that training investments yield a future stream of benefits to the firm from higher productivity growth. If it did not, firms would never have any incentive to train, however low the cost of training. I test this proposition directly by estimating a production function to investigate the impact of training on productivity growth, and the magnitude of this productivity effect with and without complementary investments in new technologies. I also test for whether productivity growth is enhanced by repeated training as opposed to one-off episodic training. This latter issue is of policy interest since an objective of HRDF is to inculcate into employers a culture of continuous training and skills upgrading.

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[20] The 1994 MITP survey provides insights into why small firms have typically been less responsive than other larger firms to training tax incentives and training levies. Asked to rank the reasons why they provide little or no training to workers, small employers tended to cite as key reasons use of mature technologies requiring little training, the adequacy of existing skills, and the lack of knowledge about how to train.

Assuming that the underlying production function is Cobb-Douglas, I estimate a random effects production function model with pooled cross-sectional data from the 1988, 1994 and 1997 surveys.[21] In this log-linear model, the logarithm of value added is regressed on the logarithms of fixed capital assets; logarithm of number of employees in four skill groups—(1) professionals, managers and technicians, (2) skilled production workers, (3) semi-skilled production workers, and (4) unskilled production and general workers; the predicted probability of training; indicator variables for ownership; dummy variables for 1994 and 1997; and twelve industry dummy variables. Predicted training is used instead of the actual training variable to address estimation biases that may arise from including an endogenous choice variable in the production function.[22] The predicted training measure, taken from the baseline probit (specification one), yields unbiased estimates of the productivity impact of training because it is uncorrelated, by construction, with the unmeasured productivity attributes of the firm in the error term.

Table 6 reports panel production function estimates for the overall sample, and separately for firms by whether they ever adopted new technology in the recent past. The results—consistent with constant returns to scale, and with higher productivity of skilled as compared to unskilled workers—are fairly typical of those reported in the literature. What is new are the training parameter estimates. Since the predicted probability of training (a continuous variable) is used in place of a (0,1) training indicator variable, the estimated parameter does not directly yield a measure of its productivity impact; instead, it has to be evaluated at the sample mean of the predicted training probability. Consider the first panel. Since the training parameter is 0.7016 and the mean predicted training probability is 0.4066, the impact of training on value added is 28.5 percent (0.7106 x 0.4066 = 0.2853). In the next two panels, the training parameter is estimated at 0.8211

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[21] The random effects model takes into account the fact that the error term in the regression is correlated across cross-sections because the same firms are observed repeatedly in the three survey years.

[22] The decision to train is related not only to measured employer and worker characteristics, but also to unobserved productivity attributes of the establishment, such as managerial talent, risk-aversion, and the like. As such, in a second-stage production function, the included training indicator variable is likely to be correlated not only with included employer and worker characteristics, but also with the error term of the production function, leading to estimation biases (see Maddala, 1983). The solution is to use predicted training from a first-stage probit that is, by definition, purged of any correlation with the unmeasured productivity attributes of the firm (see World Bank, 1997).

for the sample of firms that reported introducing new technology, and 0.7704 for the sample of firms that did not. The implied productivity impacts are 50.0 and 23.1 percent, respectively. This finding—that the productivity impact of training is twice as high in firms with new technology as it is in firms without new technology—is dramatic confirmation of the key intermediating role that training plays in realizing the productivity potential of new technology.

Table 6 Production Function Estimates with Predicted Training
And Whether Introduced New Technology Recently

Dependent variable: Log(real value added)	All Firms		Recently Introduced New Technology?			
			No		Yes	
Explanatory variables	Coef.	z-stat	Coef.	z-stat	Coef.	z-stat
Production Function						
Log(capital assets)	0.3042	32.51	0.2954	26.49	0.3268	19.88
Log(skill group 1)	0.4035	25.64	0.3962	19.09	0.4023	15.67
Log(skill group 2)	0.1237	16.13	0.1437	13.82	0.0867	8.04
Log(skill group 3)	0.0435	6.66	0.0529	5.81	0.0292	3.20
Log(skill group 4)	0.0757	11.73	0.0865	9.94	0.0465	5.12
Training Measure						
Predicted training	0.7106	9.50	0.7704	5.97	0.8211	5.45
(sample mean)[1]	(0.4066)		(0.3006)		(0.6097)	
Ownership & Time						
Joint ventures	0.1142	3.22	0.1476	3.28	0.1149	2.21
Foreign owned firms	0.1947	5.15	0.2541	5.14	0.1528	2.96
1994 dummy	0.0728	3.55	0.0761	2.68	0.0658	1.97
1997 dummy	-0.0124	-0.50	-0.0511	-1.48	0.0101	0.21
Constant term	7.9561	61.81	8.0180	51.88	7.7299	35.54
Total observations	5,618		3,640		1,978	
Number of firms	3,468		2,614		1,563	
Overall R^2	0.7896		0.7607		0.7811	

Note: 1. sample means of training probabilities predicted using model 1 are enclosed in parentheses. See Table 4.
2. industry dummies for 12 sectors included but not reported here.

Table 7 reports a similar exercise for small firms (first panel) and for medium and large firms combined (second panel). In the first panel, the estimated training parameter is 0.8371 which, at the sample mean of 0.2601, implies a training productivity impact among small firms of 22.7 percent. For medium and large firms, the estimated parameter is 0.6280 with a sample training mean of 0.632, indicating a training productivity impact of 39.7 percent. These results suggest why training is more common among medium and large firms than in small firms—training is simply more profitable (productive), possibly because larger firms make more complementary investments in new and, as the previous results indicated, more productive technologies.

Table 7 Production Function Estimates with Training
By Firm Size and By Number of Training Episodes

Dependent variable: Log(value added)	Small Firms		Medium & Large Firms		Balanced Panel Training Episodes	
Explanatory variables	Coef.	z-stat	Coef.	z-stat	Coef.	z-stat
Production Function						
Log(capital assets)	0.2575	22.25	0.3558	22.00	0.2942	16.67
Log(skill group 1)	0.4289	19.85	0.3216	14.42	0.4444	16.33
Log(skill group 2)	0.1823	14.74	0.0743	7.73	0.1062	7.79
Log(skill group 3)	0.0851	7.41	0.0091	1.19	0.0316	2.86
Log(skill group 4)	0.1212	11.35	0.0289	3.52	0.0673	6.17
Training Measures						
Predicted training	0.8731	7.54	0.6283	5.66	--	--
(sample means) [1]	(0.2601)		(0.6320)			
1 Training episode	--	--	--	--	0.0908	1.38
2 Training episodes	--	--	--	--	0.2668	3.26
3 Training episodes	--	--	--	--	0.3158	3.05
Ownership & Time						
Joint ventures	0.1191	2.31	0.0530	1.18	0.0638	1.05
Foreign owned firms	0.3737	6.05	0.0556	1.26	0.1809	2.26
1994 dummy	0.1328	4.98	-0.0187	-0.56	0.1522	4.88
1997 dummy	-0.0108	-0.33	-0.0405	-1.03	0.0898	2.76
Constant term	8.1769	49.69	8.0959	35.86	8.4661	33.16
Total observations	3,359		2,259		1,824	
Number of firms	2,212		1,475		608	
Overall R^2	0.6604		0.6468		0.7973	

Note: 1. sample means of training probabilities predicted using model 1 are enclosed in parentheses. See Table 4.
2. industry dummies included for 12 sectors but not reported here.

The third panel of Table 7 reports estimates of the impact of multiple training episodes on productivity growth, using the balanced panel of 608 firms that appear in all three surveys, and that have complete production and training information in all years. I define a categorical training variable as follows: 0 if the firm does not train in all three periods, 1 if it trains in any one period, 2 if it trains in any two periods, and 3 if it trains in all three periods. This categorization is a simple, yet parsimonious, way of incorporating training histories into a panel production function. The results are striking—compared to the omitted group (who do not train), firms are 9 percent, 26 percent, and 31 percent more productive when they train in one, two or all three periods, respectively. These results are statistically significant for firms that train in two or in all three periods, but not in just one period. Continuous training therefore enhances productivity growth while the productivity effects of episodic, one-off training may be no different from not training.

V. CONCLUDING REMARKS

The goal of this paper was to address the question: Do training levies work—in encouraging firms to provide in-service training, and in raising productivity growth? I found strong panel evidence, at least for Malaysia, that the 1993 enactment of the Human Resource Development Fund (HRDF) was instrumental in promoting increased enterprise training among all firms, but especially among medium size companies.. Technological change also had a role in inducing enterprise training, but the overall contribution of HRDF was much larger. The resulting increase in training investments, whether induced by HRDF or by adoption of new technology, had strong demonstrated impacts on productivity growth, especially when training was continuous rather than episodic, and when training was accompanied by complementary investments in new technology.

HRDF was relatively less effective among small companies, a finding common to training evaluation studies in other countries. Small firms may lag behind because of scale diseconomies in training, lack of knowledge about how to train, and low skills demand from use of mature technologies. Some of these constraints may be addressed through group training schemes, which HRDF has recently introduced, or through integrated business, training and technology development services which SMIDEC—the national SME agency—is now starting to provide. The large training effects of new technology use among small firms augur well for this latter strategy.

REFERENCES

Ann Bartel and Frank Lichtenberg, "The Comparative Advantage of Educated Workers in Implementing New Technology", Review of Economics and Statistics, February 1987, Volume LXIX, 1, pp. 1-11.

Eli Berman, John Bound and Stephen Machin, "Implications of Skill-Biased Technological Change: International Evidence", Centre for Economic Performance, London School of Economics, September 1997.

Timothy Bresnahan, Erik Brynjolfsson and Lorin Hitt, "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm Level Evidence", NBER Working Paper 7136, May 1999.

Amit Dar, Sudarshan Canagarajah and Paud Murphy, "Training Levies: Rationale and Evidence from Evaluations", The World Bank, November 2000.

S. Machin, A. Ryan and J. Van Reenan, "Technology and Changes in Skill Structure: Evidence from an International Panel of Industries", Center for Economic Performance, Discussion Paper No. 297, London School of Economics, June 1996.

G.S. Maddala, Limited Dependent and Qualitative Variables in Econometrics, Cambridge University Press, 1983.

Hong Tan and Geeta Batra, Enterprise Training in Developing Countries: Incidence, Productivity Effects, and Policy Implications, PSD Book, The World Bank, 1995.

Hong Tan and Indermit Gill, "Vocational Education and Training in Malaysia", in Indermit Gill, Fred Fluitman and Amit Dar (eds.), Skills and Change: Constraints and Innovation in the Reform of Vocational Education and Training, World Bank-ILO, Oxford University Press, 2000.

Hong Tan, Technology and Skill Needs in Malaysian Manufacturing, PSD Report to the Economic Planning Unit (Government of Malaysia), The World Bank, 2000.

World Bank, Malaysia: Enterprise Training, Technology and Productivity, World Bank Country Study, The World Bank, 1997.