



Profiting from the Innovation of Others

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Background



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- Economist by background, specialises on the determinants of FDI and the link between FDI and REI
 - North American and European economic integration
- James E Lynch India & South Asia Business Centre (ISABC)
 - Launched in 2005, Director since 2006
 - Research stream focusing on
 - Determinants & impact of inward and outward FDI to/from India
 - Link between innovation, investment in R&D and firm performance

Contents



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- Rationale
- Research objectives
- Theoretical framework
- Research methodology
- Variables
- Sample selection
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What explains differences in the performance of innovation?

- Teece (1986) – outside inventions may influence the performance of a firm's innovation
- Previous empirical research has focused on the performance implications of spillovers
- Little empirical evidence on the link(s) between
 - external know-how acquired from other firms and firm performance
 - The interactions between internally-conducted R&D, externally sourced R&D and firm performance

Research Questions



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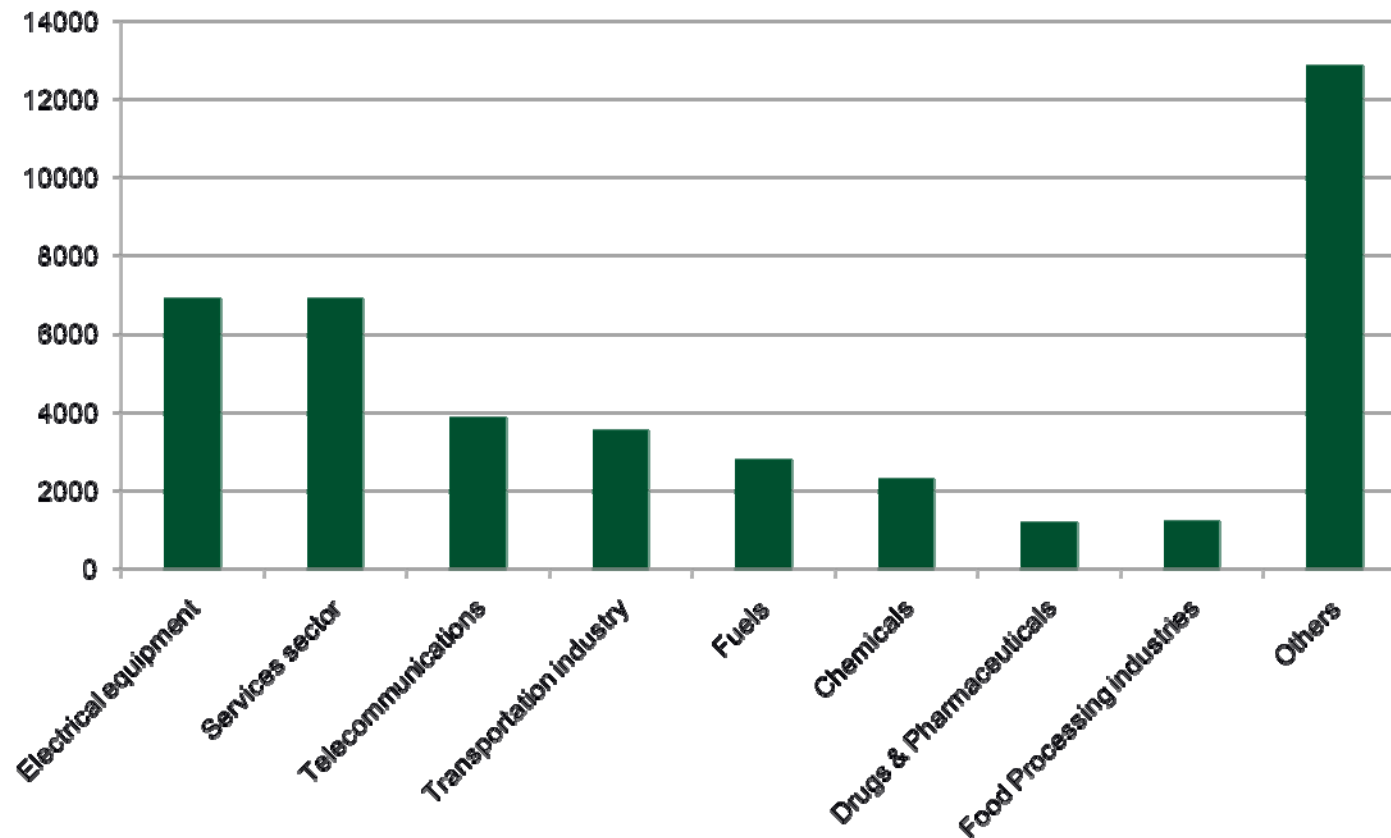
- To what extent do firms benefit from two types of knowledge, namely (1) in-house R&D and (2) scientific know-how acquired from other firms (domestic and foreign)
 - The link between firm performance, in-house R&D and acquisition of external know-how
- To investigate how externally-acquired knowledge influences the efficiency of a firm's own R&D
- To investigate which innovation strategy is more effective in enhancing financial performance
 - Exclusive reliance on in-house R&D
 - Combining internal R&D with know-how and technologies other firms develop

India's chemicals industry



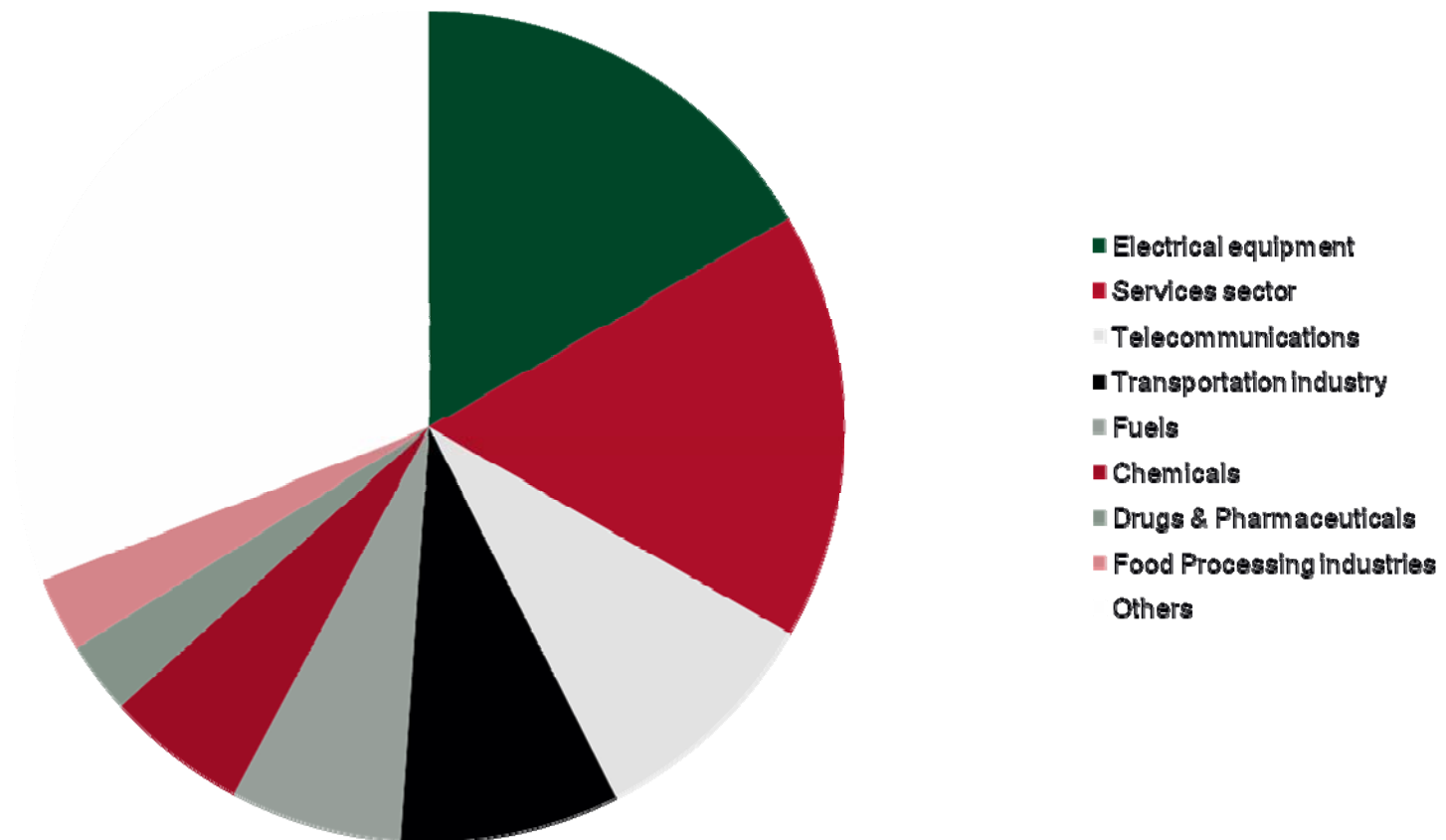
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Cumulative inflows, 1991-2006, million US\$





Cumulative inflows in % of total, 1991-2006





Stream of research that explains performance outcomes by focusing on idiosyncratic firm attributes

- Growth and performance cannot be fully explained by changes in K and L (Solow, 1957)
- Knowledge, the engine that drives performance
 - Economics – in-house R&D is thought to lead to the creation of a stock of scientific knowledge (Griliches, 1979) although such stock becomes less valuable with time (Aghion & Howitt, 1992)
 - Management
 - knowledge-based view of the firm: knowledge integration leads to strong competitive advantages (Grant, 1996)
 - Resource-based view: firm resources & attributes that include knowledge can lead to superior performance (Barney, 1991) when they are valuable, rare, imperfectly imitable and not substitutable

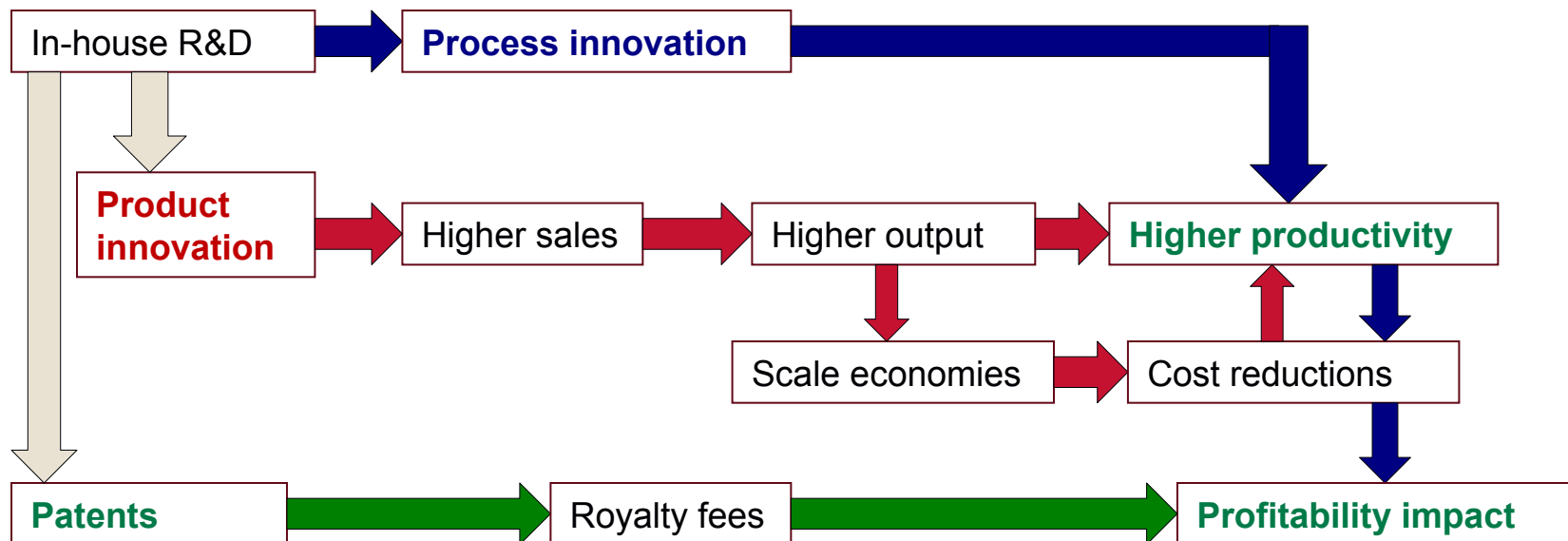


The link(s) between in-house R&D and firm profitability I

- R&D typically positively associated with organisational performance but not all firms enjoy high economic returns
 - R&D does not always lead to “non-substituable” advantages
 - Weakness of the appropriability regime - spillovers
- Theory from various research fields points to a strong correlation between firm profitability and in-house R&D

The link(s) between in-house R&D and firm profitability II

- By investing in R&D firms build an organisational stock of scientific knowledge Griliches (1979)



Hypothesis 1 – Firm profitability positively associated with a firm’s own stock of scientific knowledge created by in-house R&D



The link between external scientific knowledge and firm profitability I

- Firms can profit by buying and using know-how that other organisations develop
 - Developing products that simply meet market demand and customer needs does not ensure success - need for complementary assets (Teece, 1986)
 - A technological breakthrough by one firm may benefit other firms by triggering a technological opportunity (McGahan & Silverman, 2006)
 - Chesbrough's Open Innovation model (2003)
 - Although many firms undertake very little R&D, they succeed in finding profitable opportunities by acquiring know-how and tech expertise from the market
 - Profit by combining own research skills with outside scientific know-how



The link between external scientific knowledge and firm profitability II

- Outside R&D can also act as a substitute for internal research
 - Transaction costs
 - Acquisition from foreign v. domestic firms
 - Foreign external know-how differs considerably from domestic, external know-how in terms of (1) economic value, and (2) in the opportunities it provides a firm to attain a competitive advantage
 - Effect of foreign external know-how on firm performance likely to be stronger

Hypothesis 2 – Firm profitability positively associated with externally-sourced scientific know-how

Hypothesis 3 – The effect of foreign external know-how on firm profitability is more positive than that of domestic external know-how



The effect of external know-how on the efficiency of a firm's in-house R&D

- Sourcing externally-created know-how may negatively impact on a firm's ability to conduct its own R&D
 - Continuous accumulation of skills and competencies play “a critical role” in sustaining competitive advantages (Bettis et al, 1992) - acquisition weakens knowledge-generating capabilities needed to increase internal R&D efficiency
 - In-house R&D involves the process of generating new knowledge, and only internal R&D provides the facilitating mechanisms that strengthen a firm's ability to develop new ideas, knowledge and innovation in the future
 - “Spiral of decline” (Bettis, 1992), “not invented here” syndrome

Hypothesis 4 – The external sourcing of knowledge that a firm buys from other firms has an adverse effect on the efficiency of its own R&D

- Integration of external know-how can be arduous



- **Regression analysis on a firm-level panel dataset**
 - Indian chemical and pharmaceutical firms (237 initially, 109 in final sample)
 - 1997-2006
 - Model based on Griliches (1979) - Cobb-Douglas production function correlating firm profitability with K, L *and* R&D and pool of knowledge available to firm



H1 – Firm profitability positively associated with a firm’s own stock of scientific knowledge created by in-house R&D

H2 – Firm profitability positively associated with externally-sourced scientific know-how

H3 – The effect of foreign external know-how on firm profitability is more positive than that of domestic external know-how

- **Model**

- $$P_{it} = \alpha + \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 R_{it} + \beta_4 E_{it} + \sum \gamma D_i + \varepsilon_{it} \quad (1)$$

- P_{it} = financial performance of firm i in year t
 - K_{it} = tangible assets of firm i in year t
 - L_{it} = labor input of firm i in year t
 - R_{it} = in-house R&D of firm i in year t
 - E_{it} = external scientific know-how that firm i buys in year t
 - $\sum D_i$ = a number of control variables
 - ε_{it} = error term of firm i in year t



H4 – The external scientific knowledge that a firm buys from other firms has an adverse effect on the efficiency of its own R&D

- **H4 Model**

- **Moderated regression analysis**

- Eq (1) transformed to examine whether the regression coefficient between in-house R&D and performance is a function of external know-how

- $$P_{it} = \alpha + \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 E_{it} R_{it} + \sum \gamma D_i + \varepsilon_{it} \quad (2)$$

- If H4 valid, β_3 in (2) < β_3 in (1)
 - Sample also split into 2 sub-samples for which eq (1) is also estimated
 - firms that exclusively rely on R&D
 - firms that use both in-house R&D and external know-how



- **Profitability measure**
 - Profits before tax (Kotabe et al. 2002, Hitt et al. 1997)
- **Independent variables**
 - K input net fixed capital stock
 - L total man-hours weighted by real wage rate (Hebden, 1983)
 - Stock of in-house R&D, aggregate measure of both current and past R&D expenditures with 20% depreciation rate + 2 years lag

$$RD_t = R_t + \sum_1^k (1 - \delta)^k R_{(t-k)}$$

- External know-how, as above based on firm's expenditures on know-how royalties paid to domestic and foreign firms
- Dummy variables to control for size, time, business cycles and the use (or not) of external know-how



- **Regression analysis on a firm-level panel dataset**
 - Firm-level panel dataset
 - separate increases in firm performance that are the result of a firm's own innovation strategy v. economic growth and industry-specific factors
 - 10 year period 1997-2006
 - Chemical sector in India
 - Patents and trade secrets are effective in protecting know-how of pharmaceutical and chemical firms
 - India is emerging as a knowledge economy
 - Prowess database
 - 237 firms
 - 109 firms with data on profitability, tangible assets, labour costs and innovation over 10 years – 1090 observations
 - Includes cosmetics, fertilisers, organic and inorganic chemicals firms

Some descriptive statistics



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- **Differences in the degree to which firms rely on in-house v. external know-how**
 - 52 exclusively use in-house R&D v. 57 a combination of internal & external R&D
 - Differences across both sub-samples in terms of profitability and R&D intensity

	Whole sample (109 firms)	Firms that do <i>not</i> buy external know-how (52 firms)	Firms that buy external know-how (57 firms)
R&D intensity (R&D/Sales)	0.51%	0.47%	0.55%
Profit / Net Fixed Assets	57%	63%	53%
Capital	498	71	848
Labor costs	39	11	61
In-house R&D spending	2.21	0.72	3.44
External know-how spending	3.09	0	5.61

Any monetary value above is in crore (that is 10million)

Results I



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Table 2- The effect of in-house R&D and external know-how on firm profitability

	Model 1	Model 2
In-house R&D	0.15*** (0.05)	0.15*** (0.05)
External know-how (total)	0.04* (0.01)	-
<i>External know-how from domestic firms</i>	-	<i>-0.01</i> (0.01)
<i>External know-how from foreign firms</i>	-	<i>0.07***</i> (0.02)
Capital	0.14** (0.05)	0.14** (0.05)
Labor	0.57*** (0.05)	0.59*** (0.05)
Firm Size	0.27 (0.21)	0.19 (0.22)
Control for use of external know-how	-0.14* (0.07)	-0.14* (0.07)
Control for time ^a	yes	yes
R ²	0.87	0.88

- a 1% increase in in-house R&D improves profitability by 0.15%
- a 1% increase in external acquisition of know-how improves profitability by 0.04%
- Economic consequences of *domestic*, external know-how insignificant, but those of *foreign*, external know-how highly significant and positive

Results II



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Table 3- Sub-group analysis for the effects of in-house R&D and external know-how on firm profitability

	Firms that do not buy external know-how	Firms that buy external know-how
In-house R&D	0.19** (0.07)	0.10 (0.06)
External know-how from domestic firms	-	-0.05*** (0.01)
External know-how from foreign firms	-	0.10*** (0.02)
Capital	0.22** (0.08)	0.12* (0.06)
Labor	0.50*** (0.08)	0.61*** (0.08)
Firm Size	0.01 (0.04)	0.07 (0.05)
Control for time	yes	yes
R ²	0.79	0.88

- **Contribution of foreign, external know-how even higher than in Model (1)**
- **Negative effects of domestic, external know-how**, implying that the costs of such investments outweigh their benefits
- **Efficiency of in-house R&D**



- **This study extends previous theoretical and empirical research**
 - By helping us understand the mechanisms underlying the link between profitability and externally-acquired know-how
 - By showing that depending on its origin (domestic or foreign) external know-how may have a differential impact on performance
 - By providing evidence that contradicts past studies – external know-how is not always beneficial for firm performance and R&D efficiency
- **Reinforcement of the resource-based view of the firm**
 - It is the people that matter
 - Without unique internal capabilities that provide the essential underpinnings for an advantageous position, any technological leadership is likely to be short-lived
 - Firms' survival depends on their ability to develop new R&D skills and capabilities



- **Previous studies have argued that firms may profit by combining their own research efforts with externally-acquired know-how**
 - This study provides some support to this argument...
 - ... but domestic, external know-how has negative implications for performance...
 - ... and economic returns from internal research are economically and statistically more significant than those from external know-how
- **Efficiency of in-house R&D tends to be lower when firms rely on external know-how**
 - their research ability to develop new ideas etc. declines
 - External integration of knowledge is less efficient than internal integration