ABSTRACT

The extant literature on technological catch-up by scholars like Nelson, Winter, Amsden, Mathews and Cho has provided lucid accounts of the critical role of institutions. However, the successful catch-up stories of latecomers like Taiwan have not been easily replicated. This study developed three analytical frameworks to examine three research questions. Firstly, the research seeks to understand how technological transitions affect latecomers’ catch-up strategies, and vice versa, in a technology-intensive manufacturing industry. Second, the research seeks to examine how latecomer resource acquisition strategies vary as the industry experiences structural change. Thirdly, the study aims to understand the mechanisms of how a firm could transform from a technology follower to a technology leader, and sustain its leading technological capabilities. The study uses Taiwan’s integrated circuit industry as the empirical anchor of its in-depth case studies. Critical examples are also drawn from the experience of the integrated circuit industry in other countries.

To answer the first research question, the study explains the mechanisms behind the industry’s transitional process after the emergence of the world’s first contract manufacturer in wafer fabrication. The study found that the relationships among technological regimes, driving forces of upstream and downstream firms in the industry, choices of organizational boundaries, and network boundaries evolve through different points in time. The dynamic forces in the industry can collectively create feedback loops to technological regime. Technological transitions provide different conditions for latecomers to catch up or to leapfrog incumbents.

In addition, the thesis provides a six-dimensional framework to analyze the dynamic value systems that latecomers face, as the industry experiences structural change. Using this framework, the analysis shows how Taiwanese foundries deployed successful
resource acquisition strategies to catch up and lead the creation of frontier technologies despite remaining as contract manufacturers. Through the incorporation of resource-based view and open innovation concept, the findings show how latecomer firms can strategize their business model to move up the value chain as they progress from one dimension to the other.

Lastly, the findings show that a firm can skip or break away from internal path dependence through coevolutionary lock-ins with the industry to launch new technological paths to sustain its technological leadership. Through a virtuous circle of vision constructions, organizational endogenous strategies, and higher intensity of research and development, firms accumulate higher absorptive capacity for learning that is carried through to subsequent phases.

This study strengthens our understanding of technological transitions, which is fundamental to analyze innovation patterns of technology-intensive industries. Understanding the complex relationships between upstream and downstream firms and the industry’s innovation patterns can help policymakers to identify industry segments that can be targeted for catch-up and to identify the types of business models that can be promoted. This study posits that the catch-up process in a technology-intensive industry like the integrated circuit industry requires innovative business models and strategic resource acquisitions as the industry progresses through different phases. Finally, this study provides managerial implications of organizational learning as the study analyzes firm-level endogenous strategies and coevolutionary lock-in with industry.
ABSTRAK


Untuk menjawab persoalan kajian pertama, tinjauan ini menjelaskan mekanisme dibelakang proses peralihan industri ini setelah munculnya pengilang fabrikasi wafer pertama di dunia. Tinjauan ini mendapatkan bahawa hubungan rejim teknologi, kuasa pengerak rantaian atas dan bawahan firma dalam industri, pilihan sempadan organisasi dan sempadan jaringan berkembang melalui titik masa yang berlainan. Kuasa dinamik industri ini boleh secara bersama menghasilkan lengkuk maklumbalas kepada rejim teknologi. Peralihan teknologi memberi syarat-syarat berlainan demi mendokong pendatang lama untuk mengejar ataupun mendahului peneraju kini.

Tambahan pula, tesis ini mengutarakan suatu kerangka berdimensi enam untuk menganalisis sistem nilai dinamik yang di hadapi oleh pendatang lama, ketika industri mengalami perubahan struktur. Kerangka ini memunkinkan analisis yang menunjukkan
bagaimana faundri Taiwan melancarkan strategi berjaya pengambilalihan sumber untuk mengejar dan menerajui ciptaan teknologi tercanggih biarpun mereka kekal sebagai pengilang kontrak. Melalui penerapan firma perkilangan rantaian bawahan, kajian ini memperlihatkan bagaimana firma pendatang lama boleh merangka strategi model perniagaannya untuk menaiki rantaian nilai apabila mereka bergerak daripada satu dimensi kepada yang lain.

Akhirkata, penemuan memperlihatkan bahawa sesebuah firma boleh melangkau ataupun bercerai keluar dari jalan pergantungan dalaman melalui penguncian coevolusi dengan industri untuk melancarkan jalan teknologi baru demi mengekalkan kepimpinan teknologinya. Menerusi satu pusingan pembinaan visi berasaskan pembinaan, strategi organisasi dalaman, dan keamatan penyelidikan dan pembangunan yang lebih tinggi, firma mengumpul keupayaan meresap untuk belajar yang lebih tinggi yang dibawa kepada fasa seterusnya.

Kajian ini mengukuhkan pemahaman kita terhadap peralihan teknologi, yang mengasaskan analisis pola inovasi industri yang berintensif teknologi. Pemahaman hubungan kompleks antara rantaian atas dan bawahan firma dan pola inovasi industri boleh membantu pembentuk dasar untuk mengesan lapisan industri yang boleh disasarkan untuk pengejaran dan untuk mengesan model perniagaan yang boleh digalakkan. Kajian ini menekankan bahawa proses pengambilalihan sumber dalam sistem nilai yang berubah boleh dirancang secara teratur untuk mengalakkan pengejaran yang berjaya. Akhir sekali, kajian ini memberi implikasi ke pengurusan terhadap pembelajaran organisasi kerana ianya menganalisis strategi dalaman dan penguncian coevolusi di peringkat firma.
ACKNOWLEDGEMENTS

My utmost gratitude goes to the one and only loving God, for providing me with unconditional love, despite the mistakes I have made in life. I believe God has a reason for every turn that he plans for me. I thank God for loving and taking care of my parents, and I thank God for answering my prayers every time when my father is ill. Thanks for giving me the strength to go through each obstacle in life, ever since the first day I came to you and prayed.

I would like to express my deep and sincere gratitude to my supervisor, Professor Dr. Rajah Rasiah, for his great teaching and helpful guidance since the beginning of this study. Thank you very much for your directions and patience throughout my learning process. Very importantly, thank you for believing in me still, at times when I lose confidence in myself. Your encouragements from time to time have meant tremendous to me and kept me motivated throughout the course of this study. On top of that, thank you for introducing me to research projects headed by United Nations Conference on Trade and Development (UNCTAD), Economic Research Institute for ASEAN and East Asia (ERIA) and University of Malaya High Impact Research (HIR). Not only these research projects have offered me with numerous learning opportunities, they have also funded the entire costs of my research and supported my family expenses. Meanwhile, I would like to thank you for providing me with important contacts and access into the IC industry to conduct research fieldwork. You have also given me various opportunities to gain exposure in the international research network. Thanks for making my Ph.D. journey a very enriching one.

This research would also be impossible without the former Vice Chancellor of University of Malaya (UM), Professor Tan Sri Datuk Dr. Ghauth Jasmon. I could still recall the day when I stepped into your office, not knowing much about what to do in
life. Thank you very much for listening and believing in me. Thanks also for granting me the Bright Sparks scholarship to do a Ph.D. in UM and thanks for referring me to Professor Rajah.

I need to express my great gratitude to Dr. Lu Chih Yuan from Macronix, Mr. Lau Kean Cheong from Inari Amertron, Mr. BY Leong from Malaysia Northern Corridor Implementation Authority (NCIA) and Mr. Peter Halm from Infineon (Malaysia). Not only you have been very supportive in many aspects of the research, you have also taught me in tremendous ways the dynamics in the industry. Your teaching and support have been critical to my learning process.

For my research fieldwork in Taiwan, I would like to thank Datuk Pua Khein-Seng, Professor Yeo Lin and Mr. Chang Zi Ping for providing me with important contacts in the industry. As for my research fieldwork in Malaysia, I would like to thank Datuk Chris Tan from PEMANDU, Mr. BY Leong from NCIA again and Dr. John See from QAV Technologies for providing the relevant contacts. Special thanks also goes to Mr. Calvin Tan, Mr. Jesse Tan Kah Ann and Mr. Loh Choon Hong for your support and patience. On top of that, I would like to sincerely thank every other firm or organization that has supported and participated in this research.

Finally, I wish to thank those who have provided other forms of support during the course of this study. To my former employers and colleagues (Mr. Wong Chan Wah and Ms. Yaw Ai Lee), thanks for understanding that pursuing further knowledge was what I needed and thanks for your lasting friendship. Special thanks also goes to my sister and my two dear friends - Chooi Teng and Jyue Wei. Thanks for keeping me happy and thanks for your understanding when I cannot be around. Last, but certainly not least, I wish to dedicate this piece of research to my beloved parents. Thank you as
you brought me up with love, food and shelter despite all the hardships. I keep you in my prayers, everyday. You are the reason I keep learning.

All errors and shortcomings remain my own.

Yap Xiao Shan

Kuala Lumpur, Malaysia
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<tr>
<td>AMD</td>
<td>Advanced Micro Devices</td>
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<td>ASE</td>
<td>Advanced Semiconductor Engineering</td>
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<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
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<td>CoWoS</td>
<td>Chip-on-Wafer-on-Substrate</td>
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<td>CMOS</td>
<td>Complementary metal–oxide–semiconductor</td>
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<tr>
<td>CNSE</td>
<td>College for Nanoscale and Science Engineering</td>
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<td>CREST</td>
<td>Collaborative Research in Engineering, Science and Technology Center</td>
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<td>EDA</td>
<td>Electronic Design Automation</td>
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<td>EUV</td>
<td>Extreme Ultraviolet</td>
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<td>ERSO</td>
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<td>Global Value Chain</td>
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<td>IC</td>
<td>Integrated Circuit</td>
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<td>IDM</td>
<td>Integrated Device Manufacturer</td>
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<td>IEK</td>
<td>Industrial Economics and Knowledge Center</td>
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<td>IP</td>
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<td>ITIS</td>
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<td>JV</td>
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<td>LSI</td>
<td>Large Scale Integration</td>
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<td>mm</td>
<td>Millimetre</td>
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<tr>
<td>MNC</td>
<td>Multinational Corporation</td>
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<td>National Economic Advisory Council</td>
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<td>nm</td>
<td>Nanometre</td>
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<td>NMOS</td>
<td>N-type metal-oxide-semiconductor</td>
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<tr>
<td>OBM</td>
<td>Original Brand Manufacturer</td>
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<td>OEM</td>
<td>Original Equipment Manufacturer</td>
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<tr>
<td>ODM</td>
<td>Original Design Manufacturer</td>
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<tr>
<td>OSAT</td>
<td>Outsourced Semiconductor Assembly and Test</td>
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<tr>
<td>PMOS</td>
<td>P-type metal-oxide-semiconductor</td>
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<tr>
<td>RCA</td>
<td>Radio Corporation of America</td>
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<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>SERI</td>
<td>Samsung Economic Research Institute</td>
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<td>SMIC</td>
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<tr>
<td>SoC</td>
<td>System-on-a-chip</td>
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<td>STPI</td>
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<tr>
<td>USPTO</td>
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