

# The path dependence of local innovation systems in developing countries

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## Abstract

This paper discusses and analyses the path dependence of open and closed local innovation systems in developing countries. Path dependence entails that territorial economic outcomes evolve as a consequence of their own history. The paper aims to show that differences and inefficiencies in local innovation systems can be explained based on the contingency and irreversibility of territorial events, the inflexibility of innovation systems, path inefficiencies and sequencing of events. Innovation systems are defined as more-or-less coherent matrices of institutions impacting on innovation. Open innovation systems enable firms to acquire, combine and exploit knowledge on both products and processes from multiple local and global knowledge sources. Empirically, I analyse three contrasting case studies of low technology exports: Yiwu (China Commodity City), which mass produces low tech products at reducing profit margins; Cape Town, which produces a small number of high-priced designed products; and Yogyakarta, which produces a medium number of medium-priced products. The study shows that open local innovation systems are less likely to be locked into unwanted, path dependent development trajectories than closed local innovation systems.

## Introduction

There is a growing interest in the path dependence of local innovation systems (LIS) in developing economies. The reason is that access to new knowledge is expected to drive long-term economic development processes and to reduce the risk of an economic lock-in. Open LIS enable firms to acquire knowledge from a wide variety of sources and to introduce new technologies, which is expected to lead to economies of scale and scope, responsiveness to market changes and branching off to new industrial sectors, (Essletzbichler and Rigby 2007; Martin and Simmie 2008). By contrast, closed LIS may limit the firms' search of new knowledge to a small group of actors; firms may thus miss important pieces of the knowledge puzzle.

This study analyses if and how open and closed LIS in low tech sectors in developing countries have evolved in path dependent processes. Path dependence entails that decisions made by firm and non-firm actors of the past set into motion institutional patterns with deterministic properties (Mahoney 2000). Starting with initial small "random" events, a stochastic process emerges which forms the LIS (Arthur 1989; Martin 2010). This paper particularly assesses whether path dependence can explain how open and closed LIS at varying efficiency levels have emerged. Most studies focus on LIS in eye-catching high tech sectors, such as ICT and life science, whereas LIS in low tech sectors in developing countries remain relatively understudied (Fransen 2016; Martin and Moodysson 2011). Yet, labour-intensive firms can be the engines of economic growth and resilience, creating much needed employment in developing countries (Martin and Moodysson 2011).

There is a growing body of literature on the path dependence of LIS (Geels 2004; Martin 2010; Martin and Simmie 2008; Martin and Sunley 2006; Niosi 2002; Scot and Geels 2007; Strambach 2010). The literature has greatly contributed to the understanding, but has remained relatively weak on empirical analysis. This study aims to contribute to the literature by operationalising and testing path dependence based on previous studies (esp. Arthur 2000) and related studies in sociology (Mahoney 2000) and political science (Pierson 2000). It traces the major and minor events leading to the contemporary LIS and unbundles path dependence in five variables (Arthur 2000): contingency, non-ergodicity, inflexibility, path inefficiencies and sequencing in time. It offers two contributions to

literature. First, this study incorporates all elements of path dependence, while most scholars focus on one aspect of path dependence: the inflexibility of LIS. Second, study results show that open LIS are less prone to be locked into unwanted development paths. Openness is more than just acquiring data from multiple sources: the question is what data firms acquired. The research findings show that LIS conditioning firms to acquire product or process innovation are more likely to be locked in than open LIS combining the two.

The study analyses three contrasting case studies of low-technology exports in emerging economies: China Commodity City, which mass produces low-tech products at low costs; Cape Town, which produces a small number of high-priced designed products; and Yogyakarta, which produces a medium number of medium-priced products. This paper first discusses theory on the path dependence of LIS, followed by a brief description of research methods and the three case studies. The case studies will subsequently be compared, followed by a debate and conclusion.

## Theory

This section aims to recommend core variables to measure the path dependence of LIS. In order to do so, it first defines path dependence and discusses the current state of literature on path dependence of LIS.

Path dependence is one of three evolutionary economic perspectives (Martin and Simmie 2008). Other perspectives are those on long term technological change, such as Schumpeterian waves of creative destruction, and those aiming to understand economic evolution from the perspective of the routines of firms (MacKinnon 2009). Path dependence is chosen as a relevant perspective, because institutional systems such as LIS are expected to be path dependent due to increased returns and institutional hysteresis (Hall and Soskice 2000; Krugman 1991; Martin and Simmie 2008; North 1990; Pierson 2000). If the institutional matrices create incentives for piracy, North observes, then people will invest in becoming good pirates (Pierson 2000). By the same token, if the LIS creates incentives for product innovation, firms are more likely to innovate products.

Economic path dependence has two godfathers: David (1985) and Arthur (1989). Both their models start with the accidental stochastic emergence of a technology, economic structure or institutional system. This system may have emerged accidentally, but it becomes progressively inflexible and is assumed to persist until an external shock transforms the development trajectory (Martin 2010). David (1985) for instance argues that the QWERTY terminal is an inflexible technology, which is widely used despite being inferior to an arrangement offered by Dvorak in the 1930s. By the time that a better alternative was available, QWERTY was widely used, people were trained and computer networks were adapted. Network externalities had arisen. David concludes that sequencing of events and not economic maximising explains the survival of the QWERTY technology (Liebowitz and Margolis 1990).

This paper focuses on Arthur's (1989) model of increased returns, who argues that once a new technology or institutional system has emerged, positive feedback mechanisms result in an irreversible and inflexible institutional or technological system. His 'increased returns' perspective opposes that of a market equilibrium, whereby each step away from an equilibrium results in decreasing returns (Pierson 2000). Using the QWERTY example once again, his argument is that the longer QWERTY technology is used, the more advantages of scale arise and the higher the costs of switching (Pierson 2000). The technology becomes quasi-irreversible. Technologies, organizations and institutional systems can thus be locked into inferior development paths even if more efficient

alternatives are possible (Martin and Sunley 2006). A lock-in by historical events therefore means a lock-out of something better (Liebowitz and Margolis 1990).

Various scholars on innovation systems define path dependence more narrowly as stable systems of institutions, actors and networks. They implicitly adopt the perspective that LIS change slowly, which creates stability (Essletzbichler and Rigby 2007; Strambach 2008). LIS have a certain hardness which increases their stability, due to compatibility standards and sunk investments (Geels 2004; Geels and Scott 2007). The main notion is that of 'punctuated equilibrium', whereby periods of relative stability alternate with major path breaking shocks that shift the LIS into a new configuration (Boschma and Frenken 2007; Martin 2010; Martin and Sunley 2006). This perspective is problematic for three reasons. First, stability is not always history dependent and hence does not prove path dependence. Stability may also be caused by a market equilibrium. Second, the emergence and decline of development paths themselves may also be path dependent. It is not very enlightening to argue that a new development path emerges due to an external shock and hence can't be explained, predicted or planned. Third, LIS are not stable but change incrementally and have a level of plasticity, which refers to the continuity of change without necessarily breaking out of existing paths (Strambach 2008). It is far more interesting to study the path dependence of change than zooming in on stability in between unexplained ad-hoc shocks (Martin and Sunley 2006). The notion of punctuated equilibria has therefore slowly given way to that of incremental institutional change (Witt and Redding 2013). Geels (2004) and Scot and Geels (2007) combine the perspective that 'institutions are stable' with that of incremental change by arguing that change occurs in small institutional niches within which actors develop innovations outside the mainstream LIS. If successful, innovations may however be up-scaled to the mainstream LIS. Martin and Simmie (2008) also include path decay and renewal in their models.

While scholars have built up a strong academic case that LIS are likely to be path dependent, empirical prove has remained slim at best. The concept is often not operationalised beyond the 'institutions create stability' paradigm and institutional change is not explained. More-over, the few empirical studies that exist use different sets of indicators and are therefore hard to compare. In addition, not all studies consider rival explanations and quite easily accept that the LIS is explained by path dependence. Williamson (1993) already warned us is that that history may indeed matter, but neo-classical theory can also explains a lot as agents have maximising behaviour. Institutional scholars may add that institutions and routines also condition the behaviour of agents. How can we then prove path dependence instead of (or on top of) rival theories?

I operationalise path dependence as a self-reinforcing and stochastic sequencing of events that create increased returns, rigidity and possibly change (Arthur 1994; Glückler 2007; Mahoney 2000). I perceive the LIS as an enduring institutional system, which changes incrementally and shows continued plasticity due to internal and external events. Institutional genesis takes place during what Mahoney (2000) calls 'critical junctures'. This operationalisation allows me to use the five variables of path dependence as identified by Arthur and to add findings from recent literature on LIS and influential articles in sociology (Mahoney 2000) and political science (Pierson 2000). The variables are: contingency, non-ergodicity, inflexibility, path inefficiencies and sequencing of events. I am fully aware that other models exist (for instance: Martin and Simmie 2008; Niosi 2002; Pierson 2000) and I have tried to incorporate some of their ideas.

- (1) *Contingency* entails that path dependence is a stochastic, unpredictable process. In particular, small events that happen at the right moment may have large random effects, including the emergence of local institutions, institutional systems or industries (Krugman

1991; Pierson 2000). The emerging institutions are not necessarily the most efficient, if only because individuals have bounded rationality and may behave opportunistically. Even if each individual would make a rational decision, which increases efficiencies at that moment of time, the collective outcome may be inefficient (David 2000; Liebowitz and Margolis 1990).

(2) *Non-ergodicity*. A defining characteristic of path-dependence is the inability to shake free of history (Martin and Sunley 2006). As a result, the probability distribution at time  $t+1$  is expected to depend more upon its history than on its condition at time  $t$  (Liebowitz and Margolis 1990: 981). This notion is drawn from biology, within which evolutions are irreversible. In economics, however, the concept is problematic because institutions might always be reinstalled (Martin and Sunley 2006). I therefore adopt David's (2000) concept of 'local irreversibility', which entails that the multiple interactions within complex institutional matrix of a territory lead to quasi-irreversibility. After an event, even a minor event, a ripple effect occurs with institutions, actors and networks likely to adapt and learn from the event. This leads to a massive number of interconnected system adaptations and knowledge accumulation. These knowledge accumulation and minor changes cannot fully be reversed, leading to a the irreversibility of LIS and other complex institutional systems.

(3) *Inflexibility*. Once an initial chance event leads to new institutions within a territory and a critical mass happens to develop, positive feedback mechanisms are likely to occur (Martin 2010; Pierson 2000). This process creates a path inertia, in the sense that a process in motion stays in motion, due to a self-reinforcing or reactive sequence of events (Mahoney 2000). Positive feedback mechanisms of an LIS are likely to be place-specific, as people tend to search for knowledge within close proximity (Boschma 2005). Arthur (1994: 112) identifies four conditions for positive feedback mechanisms: sunk costs; learning effects; coordination effects (network externalities), and adaptive expectations (adjust expectations and routines to existing conditions). Scholars have linked these to agglomeration externalities (Martin and Sunley 2006), spillover effects (Pierson 2000), advantages of scale and scope (Coe et al. 2004) and the accumulation of the knowledge base of the firms (Essletzbichler and Rigby 2007).

Positive feedback mechanisms may lead to different development trajectories. One is a 'lock-in', whereby an emerging institutional system starts exhibiting hysteretic rigidities (David 2000). Such a development path is risky, as industries become constrained in adapting to shifts in markets, the rise of competitors and industrial decline (Martin 2010). In short: it ends up in a place anyone wants to avoid (David 2000). A second development trajectory is more open, enabling industries to continuously adjust to market volatility and change (Martin 2010). Martin and Sunley (2006) argue that increasing returns of learning, networking and agglomeration lead to a lock-in, whereas competence building, organisational and institutional creation and variety may enable openness and change. Absorptive capabilities also enable firms to innovate and adapt. Development trajectories which allow for plasticity, local experimentation and institutional niches within an otherwise inert LIS, might be placed in the middle of these two extreme development trajectories (Geels 2007; Strambach 2008).

(4) *Path inefficiencies*. I identify two types of path inefficiencies, which may occur at varying levels. The first is a lock-in as an outcome of a path dependent process (David 2000). It may be indicated by an overly focus on knowledge from a few local actors or global buyers, since such a limited search for knowledge leads to the exclusion of other knowledge. The second type is system failure, whereby the LIS does not take off or does not adequately stimulate firms to innovate. There is no shortage of potential, place-specific indicators of system inefficiencies. They range from not fully meeting Arthur's positive feedback mechanisms, to specific institutional or policy problems, failures of interactive learning, low levels of absorptive capacity of firms, clusters and regions (Martin and Sunley 2006; Zhara and George 2002), being captivated by value chains (Kaplinsky and Morris 2001) to weak agglomeration economies and government failure. (Martin and Simmie 2008; Niosi 2002). Liebowitz and Margolis (1990) identify three levels of path inefficiencies. First degree path inefficiency comprises efficient LIS which have successfully taken away market imperfections and enable maximising behaviour. Second-degree path inefficiencies entail that imperfect information and bounded rationality lead to decisions which appear to be efficient but are inefficient with hindsight. Third degree inefficiencies entail that the LIS hardly takes off or is locked in.

(5) *Sequencing*. The sequencing of events is a crucial part of path dependence. The sequence of events can be grouped in phases (Martin and Simmie 2008; Nelson 1994; Niosi 2002), but is it still useful to explicitly identify a range of critical and minor events first (Mahoney 2000). The sequencing is expected to be stochastic and irreversible (in David's sense of local irreversibility). This section adopts Mahoney's (2000) sequencing, whereby (1) a historical chance event triggers the development of initial institutions following a relatively deterministic (stochastic) pattern; (2) a critical juncture of two development paths leads to the emergence of an LIS; after which (3) a self-reinforcing sequence of events leads to the reproduction of the LIS over time (Mahoney 2000: 535).

*Time 1 Historical chance events*. These are accidental initial events which set in motion a stochastic development trajectory (David 2000; also see the section on 'contingency'). They lead to the emergence of individual institutions, which at a later stage may become the backbone of an LIS. The initial event may be triggered by environmental and socio-economic conditions, such as the availability or lack of resources. The first phase of a product life cycle (Nelson 1994) may be seen as a historical chance event leading to the emergence of a new institutional system: when a firm develops a new product, it results in experimentation and the formation of institutional firm routines, but does not immediately lead to a full fledged LIS. That only happens after the new technology becomes the norm (Martin and Simmie 2008).

*Time 2 Critical juncture*. Mahoney (2000) proposes that the intersection of two or more development trajectories may produce a major event, which may lead to the emergence or change of an LIS. Literature offers ample examples of critical junctures. To follow up on the example of a product life cycle, once a dominant product is selected, it may merge with existing economic institutions within a territory and form a new, coherent production and innovation system. The concept of 'windows of locational opportunity' also offers a point in case, whereby a new technology or industry from outside a territory is combined with local institutions, leading to the emergence of a new industry (Martin and Simmie 2008; Martin and Sunley 2006). A third example is based on Geels and Scot (2007) and Strambach (2008) :

when institutional niches or the plasticity of institutions proves successful in generating novelty, they might be up-scaled to the mainstream LIS.

*Time 3 Self-reinforcing.* During this period the LIS is reproduced, corresponding to the stage of relative stability, incremental change and plasticity of institutions (Maloney 2000: 535). In process of reactive sequencing, the contingent period corresponds with a new, relatively stable development path (see the section on 'inflexibility').

## Methods

The study traces the development paths of LIS in Cape Town, Yiwu (China's Commodity City) and Yogyakarta and unearths the sequence of events that formed the LIS. Indicators are derived from theory (table 1). Dependent variables are the type and inefficiencies of the contemporary LIS. The type of LIS is either open or closed. Open LIS collect global and local knowledge and combine product-innovation, as indicated by the aggregate level of product innovation (measured in accordance with OECD (2005) on a scale from 1 to 4) and process-oriented (indicated by a priority given to process innovation)<sup>1</sup>. Process-innovation is also indicated by large firm sizes, as firms are likely to mass produce, and by reducing profit margins. Closed LIS exhibit market failure, as firms ignore knowledge out there, leading to sub-optimal innovations. LIS inefficiencies are indicated by institutional gaps (limited knowledge exchange or services offered for certain aspects of the innovation system, be it business services, finance, copyright regulation and control or knowledge generation and networks). The LIS is compared to counterfactuals in order to assess if better alternatives exist.

The first independent variable is contingency, indicated by chance events leading to the emergence or change of institutions and/or the LIS. Non-ergodicity is indicated by the fact that initially formed institutions become defining institutions of the present LIS, major and minor events follow a logical sequence and firms learn and adapt after events, leading to local irreversibility. Inflexibility and inertia can either be measured as a lock-in or openness and incremental change. Lock-in is indicated by a combination of sunk costs in machines and the like, in 'soft sunk costs' in training, learning and networking and the adaptation of expectations to past experiences. In order to fully include local agglomeration economies, we also include the sharing of infrastructure and matching of labour. Firms can be locked in by the rigidity of global institutions, indicated by a high export rate and a high dependence on the knowledge and brands of global buyers. By contrast, openness is indicated by knowledge acquisition from a wide range of local and global sources, absorptive capacity of firms (Zahra and George 2002), competence building of firms, local experimentation, institutional and organisational building and the presence of institutional niches. The sequencing of events is analysed in initial events (time 1), critical events (time 2) and a self-reinforcing period (time 3).

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<sup>1</sup> The reason is that. In order to filter out process innovation needed because of new product development, the study assesses a focus on processes.

*Table 1: indicators*

Variables	Abbrev.	Indicators	Sources		
<b>DEPENDENT</b>					
Openness of LIS	LIS.T	Level of firms' product innovation	Survey		
		Priority to process innovation	""		
		Annual turn-over	""		
		Knowledge networks	Interviews		
LIS inefficiencies	LIS.I	Institutional gaps	""		
<b>INDEPENDENT</b>					
Contingency	CON	Chance events	""		
Non-ergodicity	ERG	Individual past institutions become core of LIS	""		
		Logical sequencing of events	""		
		Local irreversibility: learn and adapt	""		
Inflexibility: lock-in	LOC	Sunk costs	""		
		Training and learning	Survey		
		Networking	""		
		Adaptive expectations	Interviews		
		Matching and sharing	""		
		Export rate	Survey		
		Interaction with global buyers	""		
		Using own brand	""		
		Inflexibility: open system	OPE	Openness of LIS (local and global)	Interviews
				Absorptive capacity	""
Competence building	""				
Local experimentation	""				
Institution/ organisation building	""				
Sequencing of events	SEQ	Institutional niches	""		
		Individual institutions formed at time 1	""		
		Pathways meet at time 2	""		
		LIS emerge at time 2	""		
		Self-reinforcing sequence of events confirms time 3	""		

Data is collected in a survey of 301 firms, 83 semi-structured interviews with firm and non-firm actors (experts, local governments, chambers of commerce, business associations) and secondary data. Survey data is solely used to determine the type of LIS, while the study otherwise uses qualitative data analysed in Atlas-Ti.

Mahoney (2000) recommends process tracing in order to sequence events and their preconditions (Mahoney 2000). Process tracing aims to make inferences about the most convincing explanation of the type and efficiencies of LIS, in which ways and to which degrees. I first trace the temporal processes of each case study and subsequently conduct a comparative evolutionary institutional analysis based on variables and indicators.

*Table 2. Data collection methods*

	Survey	Semi-structured interviews
Yiwu	118	19
Yogyakarta	100	41
Cape Town	83	23
<b>Total</b>	<b>301</b>	<b>83</b>

## Findings

This section describes the sequence of events for each case study and conducts a comparative analysis, triangulating quantitative data as given in table 3 with qualitative and secondary data. The text refers to variables in between brackets and in italic, linking the historical heuristic to a comparative analysis of variables. The text also refers to events and interventions indicated in the figures.

*Table 3: selected case study data*

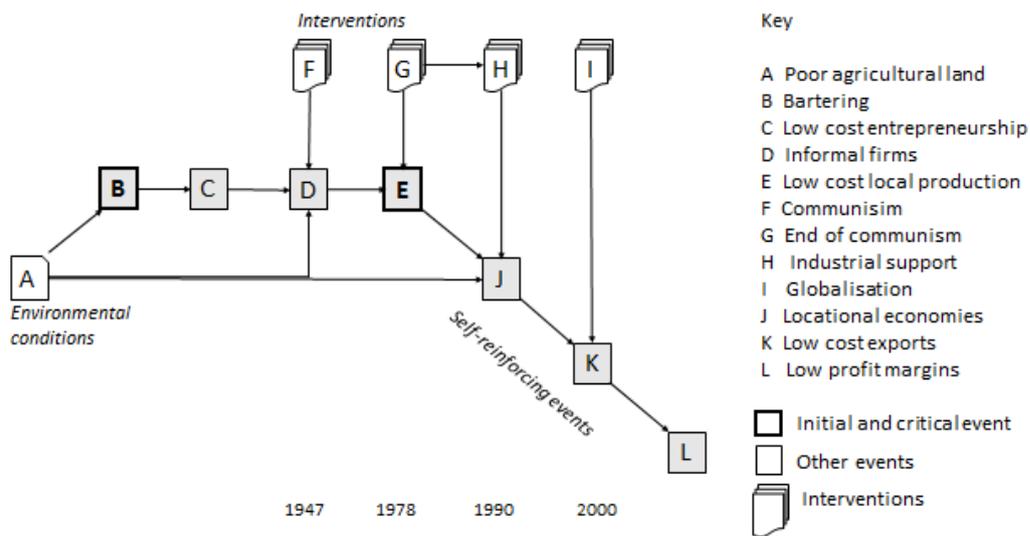
	Min.	Max.	Median	Yiwu	Cape Town	Yogyakarta
Product innovation (LIS.T)	1	4	2	1.5 <sub>a</sub>	3.0 <sub>b</sub>	2.1 <sub>c</sub>
Process innovation (LIS.T)	0	1	0	.5 <sub>a</sub>	.0 <sub>b</sub>	.0 <sub>b</sub>
Annual turnover (US\$ 1.000) (LIS.T)	.4	16000	2	4500 <sub>a</sub>	196 <sub>b</sub>	361 <sub>c</sub>
Staff training (ERG/LOC)	0	1	1	.7 <sub>a</sub>	.3 <sub>b</sub>	.4 <sub>b</sub>
Export level (LOC)	0	1	.7	.8 <sub>a</sub>	.4 <sub>b</sub>	.7 <sub>a</sub>
Interaction global buyers (LOC)	1	5	4	4.4 <sub>a</sub>	3.3 <sub>b</sub>	3.4 <sub>b</sub>
Own brand in exports (LOC)	0	1	1	.5 <sub>a</sub>	.8 <sub>b</sub>	.4 <sub>c</sub>

<sup>abc</sup> Rows with different values differ significantly at  $p < .05$  in the two-sided test of equality for column means. Test assume equal variance.

### Yiwu

*Initial event* (event B in figure 1). For ages, Yiwu has been a poor, relatively isolated rural area with limited farming opportunities (environmental condition A). In order to survive, people picked up their shoulder poles and travelled great distances in order to barter locally produced brown sugar (event B; *CON*; Qi 2000). This entrepreneurial culture, with hard work at low profit margins (event C), was combined with a ‘guanxi culture’, whereby informal social relations override formal ones. Business remained within the family and informal links were treated as more important than formal ones. Formal relationships with governments were treated with mistrust (*SEQ*). Business learned and adapted to their harsh environment, whereby informal family businesses survived by bartering at low risks, acquiring production factors and knowledge from informal instead of formal networks (*ERG.I*). As the government controlled resources and travel routes, their relationship was patriarchal (Mitusses 2010; Wang 2013; respondent #129). The evolving entrepreneurial culture became that strong that bartering and trading continued at great personal risk (D) during communism (F; *ERG*). The government condoned these small, informal, private firms, as Yiwu was rather isolated from the political heat (GaoHua 2000; Si et al. 2015; Qi 2000).

Figure 1: sequencing of events in Yiwu



*Critical juncture* (event E). In the early 1980s, the communist party slowly lifted the ban on private firms (intervention G). However, as trading and travelling was still formally forbidden, nobody knew what was allowed and what not. Yiwu's informal family businesses spotted an opportunity and started producing and trading. Due to massive shortages of low-cost necessities and limited competition in China, the demand surged. An informal small commodity-market emerged overnight as early as 1982 (event E). This posed a challenge to city council, as markets were still strictly forbidden. The council of Yiwu, supported by a similar ongoing process in neighbouring Wenzhou, took a calculated risk by formally approving the market in 1984 (GaoHua 2000).

Over the next 15 years, Yiwu expanded and consolidated its leading position as a trader of low-cost and rude low-technology products, such as soap and clothing (Foste 2000). During the early years, competition remained limited as firms located in other regions were held back by a more conservative local government and a less entrepreneurial spirit. The Chinese government used the experiences of Yiwu and similar territories to introduce economic institutions, such as property rights, licensing for industries and trading, financial services, industrial standards, education and training (Yueh 2013). As an economic institutional system slowly evolved, Yiwu increasingly faced competition. But by then, firms in Yiwu had developed first-mover advantages.

Yiwu became the largest wholesale commodity market in China in 1991 and continued its explosive growth during the 1990s. The success of the market and the relatively enabling industrial policies (intervention H) attracted more and more traders. Since the mid 1990's, they invested their accumulated capital and knowledge by setting up factories in around Yiwu (SEQ/ Ding 2000). The accumulation of knowledge, people and capital and the continued infrastructural investments created locational externalities (event J).

*Self-reinforcing phase:* Around the year 2000, global buyers discovered Yiwu in a search for low-priced mass production (intervention I; SEQ). The Chinese firms were ready: they benefited from accumulated competences and locational externalities. The opportunity to mass produce internationally fitted well within their culture of 'hard work at low margins' (ERG). Exports had nevertheless a huge effect on the firms, as it led to their integration in global value chains (Bellandi and Lombardi 2012). As global buyers offered brands, designs and markets, local firms reduced their

costs by firing their designers and reducing marketing expenditure (respondents # 1, 25, 31, 68 and 95).

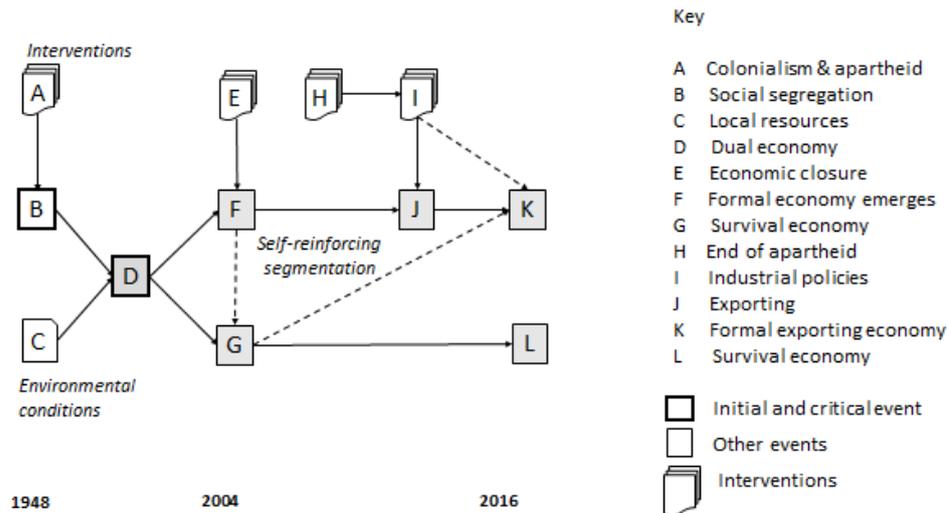
The past decade the first mover advantages seem to turn into rigidities (*LOC*). There are considerable sunk-costs in factories (in producing low tech and intermediate products such as plastics, machines and in excavating raw materials). In addition, it is not an overstatement to argue that the whole city, with excellent road infrastructure, airport, low-cost housing and wholesale markets, is designed to enable low cost production, trade and logistics. The lock-in is also indicated by the increased dependence on knowledge and sales of global buyers in quasi-hierarchical global value chains (see table 3), in the absence of formal local knowledge networks. Locational externalities, as already mentioned, further increased the exit costs of Yiwu's development path (*LOC*). Firms forgot that product innovation can also be viable, because they had only accumulated competences on process innovations. The firm's expectations are formed by their traditional culture of 'hard work at low margins' and moulded by the global markets, whom maintained a strong control on brands and designs.

*Contemporary LIS:* The LIS is strongly biased towards process innovation, with significantly higher levels of process and lower levels of product innovation the LIS in Cape Town and Yogyakarta (table 3; *LIS.T*). Respondent #72 even went as far as arguing that 'Innovation is not important for Chinese import and export companies. We just follow customer instructions'. Firms are still primarily locally owned family businesses (79%) and local networks are still informal and limited to friends and family. Firms network with governments in order to obtain access to resources such as labour and markets, instead of access to new knowledge (*ERG*; Matussis 2000; Wang 2013; respondent #129). However, as the complexity and size of the economy increases, the limits of informal knowledge exchange become apparent (*LIS.I*). Weak local knowledge networks and a high export shares (table 3) further the dependence on knowledge offered by global buyers (*LOC*). Respondents who became millionaires at the early stage of exportation note that their profit margins have reduced, often to less than 1% (event L). Many are therefore diversifying to real estate.

Government and experts express concern about Yiwu's future, because its level of product innovation remains far below that of other Chinese cities. This has culminated in new innovation policies. Possibly as a result, there are some cracks in the by now unwanted LIS (*LIS.T*): a few large existing and new small firms experiment with product innovation (*OPE*) and the government has set up a design incubator (*OPE*), which attracted a few design companies. About 11% of all firms experimented with product innovation, but this took place in isolated departments, small firms or the new and niched group of designers (*OPE*). It concerns far less than 1% of all products.

## Cape Town

Figure 2: sequencing of events in Cape Town



*Initial event* (event B in figure 2). South Africa's period of colonialism and apartheid (intervention A; CON) introduced a government structure with a limited social base: it mainly served the small group of white settlers while oppressing the majority of the population. The government formalised social segregation across all aspects of social life (event B; Gradín Lago 2103; Wilson 2011). Social segmentation is seen in urban planning (Pieterse 2010), social networks (Adato et al., 2006), education (Kruss et al., 2010), the labour market (Gradín Lago, 2013), etcetera. As people identify with their specific local environment and social network, segmentation reinforces itself (ERG; Cornelissen and Horstmeier 2002).

*Critical juncture* (event D). The segmentation was also economic (SEQ). South Africa's rich resources (environmental condition C) primarily benefited the white populace. White entrepreneurs owned and managed large firms, while black South Africans faced virtually impenetrable legal and social barriers in setting up and running a firm (Cornelissen and Horstmeier 2002; Iheduru 2004; Wilson 2011). The boycott on South African products, which ran roughly from the 1960s till early 2000, resulted in import substitution. Firms producing low-tech products in Cape Town could now replace imports. As the white middle class craved for upmarket products, the sector specialised in relatively small numbers of designed ceramics, jewellery and decorative items (event F).

*Self-reinforcing phase*. Two separate development paths had emerged by the end of apartheid: those of formal and informal firms. Formal firms were owned by white South Africans and benefited from a reliable government, industrial policies, financial services, clustering, excellent education and low cost labour, which enabled them to accumulate knowledge and skills (SEQ, OPE; DTI 2005; Kruss et al. 2010; Wesgro 2005). They focused on product innovation for South Africa's middle class, without investing in production technologies. Sunk costs thus remained low (OPE). By contract, informal firms were owned by black and coloured South Africans living in peri-urban squatter settlements and survived by producing low tech, low quality products at the bottom of markets (event G). Isolated from markets and knowledge, the firms hardly accumulated knowledge and skills. Most firms were poverty-driven; were not motivated by risk-taking maximising behaviour, but by survival. Then, when apartheid was nearing its end in 1991, the government made life even harder by banning informal trade (LOC; Wesgro 2005).

The end of apartheid (event H) led to drastic policy changes, including changes in industrial policies (event I). Municipalities were given a developmental role for pro-poor growth (Nel et al., 2009; Rogerson, 2003 and 2010), small and medium-sized firms were supported (Herrington et al., 2010) and black entrepreneurship and employment were promoted through Black Economic Empowerment initiatives (Iheduru 2004). The government set up formal policies and programmes in support of the craft sector, a major low-tech sector in Cape Town, whereby Cape Town became one of the three handicraft hubs in South Africa (DTI, 2005; DACST 1998). Cape Town proactively developed policies and support mechanisms in support of craft firms.

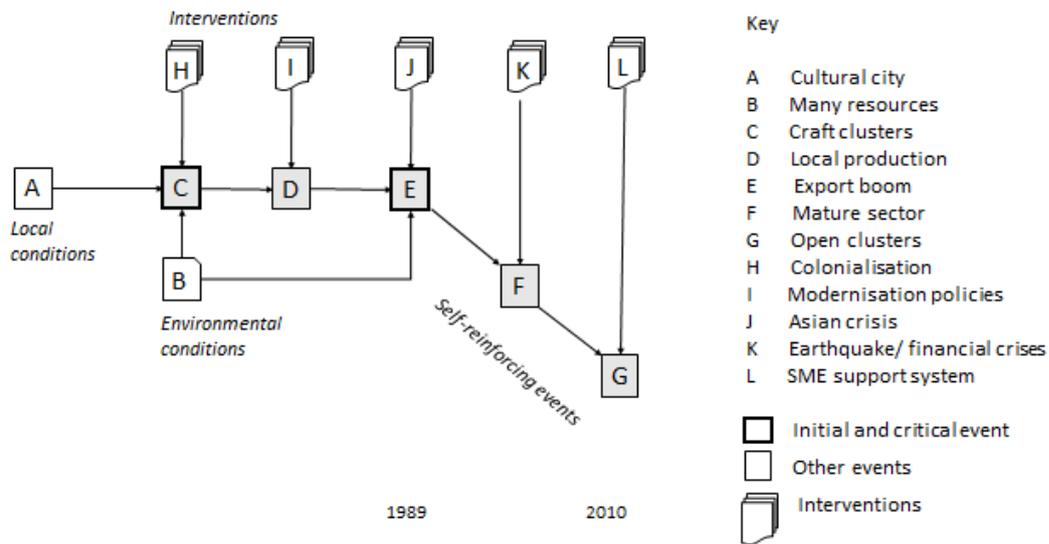
The impact of these policies on segmentation is questionable at best (Devey et al. 2006; Iheduri 2004; Nel et al. 2009; Padayachee 2013). Racial segmentation is still mirrored in the spatial structure of Cape Town (Pieterse 2010), racially structured social networks (Adato et al. 2006), skewed access to and persistent differences in the quality of education (Kruss et al. 2010), and the dysfunctional labour market (Gradín Lago 2013). In handicrafts, the sector remains segmented between formal and informal firms (Fransen and Helmsing 2016). A main reason for the limited impact, besides government failure (Nel et al. 2009; Rogerson 2003), is that informal institutions urban physical structures change very slowly (*LOC; SEQ*).

The opening of exports and recent industrial policies support product innovation of formal firms. For instance, Cape Town became the World Design Capital in 2014 and one area in Cape Town (The Fringe) has been designated as a design-oriented business and science park. Agglomeration economies arise, because firms networks enable learning, firms can relatively easily find high skilled designers and knowledge infrastructure is shared. Global buyers visit Cape Town searching for innovative designs. The conjunction of local agglomeration economies and global value chains further lock firms into product innovations, at the exclusion of process innovation (*LOC*). The locked-in segmentation shows some cracks as a belated effect of policy changes. A group of informal firms has managed to formalise, heavily supported by Cape Craft and Design Institute (CCDI; *OPE*). However, the majority of informal firms are still poverty driven.

*Contemporary LIS:* The formal LIS has a higher level of product and a lower level of process innovation than the other two case studies (*LIS.T*). This coincides with the smallest firm size, as firms focus on a limited number of new and creative products, and strong networks among firm and non-firm actors. The products are occasionally exported, often in the brand name of the South African firm (table 3). The LIS enables firms to charge high product prices. One initial institution still forms the core of the LIS: segmentation. Informal firms produce small quantities of products for formal firms on order, but don't translate their experiences into upgrading, because they lack the absorptive capacity and are not supported by government (*LIS.I*). The LIS appears unable to break down segmentation, even though some firms breach the barrier. Ironically, formal firms hardly creates employment as well as they only produce small quantities and therefore don't address inequality and segmentation via employment creation either. In that sense the LIS is still locked-in (*LOC*).

## Yogyakarta

Figure 3: sequencing of events in Yogyakarta



*Initial event (event C).* Yogyakarta, known as Maratam at the time, has been the cultural centre of Java for centuries. It housed the Maratam Kingdom from the 8<sup>th</sup> till the 10<sup>th</sup> century, when the Borobodur (Buddhist temple) was built –and Maratam Sultanate in the 15<sup>th</sup> and 16<sup>th</sup> century (COM). In the latter period, Kotagede – now the main pottery cluster – housed the Sultanate. These periods spurred the building of Buddhist and Hindu temples (such as the Borobudur) and of religious artifacts (local condition A). Production was clustered in about 10 villages around Yogyakarta (event C).

*Critical juncture (event E).* The production of Javanese artifacts continued and extended to other culturally inspired products such as batik clothing, jewellery and pottery. The industry can best be described as an unsupported, informal economy (event D). In the 1980s, Yogyakarta's small clustered firms had hardly evolved: family businesses were handed over for generations and still produced similar designs with similar production methods and tools, still targeting the Javanese market (event D; Ismalinda 2011). Dr Habibie, Minister of Research and Technology during the 1970s and 1980s had installed policies to modernise Indonesia's industry via state-led heavy industries (intervention I; ERG). The interventions were one-sided: they supported state-led, capital-intensive industries, but ignored Indonesia's many clustered informal firms (Wengel and Rodriques 2006; Wie 2006).

The end of Indonesia's oil boom and the Asian financial crisis in the 1990s shocked markets and led to financial constraints, forcing the Indonesian government to abandon its expensive industrial policies. Instead, the Rupiah depreciated and exports of local products were promoted. As a result, exports of large firms dropped, while exports of small firms, which tend to use local resources, witnessed an explosive growth (SEQ; Wengel and Rodriques 2006; Wie 2006). In Yogyakarta, change set in when the trading company *Out of Asia* relocated from Bali to Yogyakarta in order to benefit from lower salary levels (about 1/3<sup>rd</sup>) and skilful local artisans. *Out of Asia* was owned by an Australian designer, well acquainted with western designs and market trends. It was the first trading company in Yogyakarta, introducing contemporary designs and combining products from various clusters (respondents # 5, 11, 37 and 53). Respondent #5, who worked at *Out of Asia* at the time, remembers that profit margins were sometimes as high as 100%, leading to profits above US\$ 1 mln

a year. This was unheard of in the traditional industry. High educated designers, whom had always regarded the traditional industry as a left-over from the past, joined *Out of Asia* only to start their own trading company thereafter. This group is called the '*Out of Asia* alumni' (*SEQ*). The industry boomed and experimented with top-end niche markets and mass production for retail chains such as *IKEA*. The entrepreneurs refer to this period as the 'golden age' (event E; respondents # 5, 6, 10, 11, 12, 37, 53).

*Self-reinforcing phase*: The sector slowly matured (event F). Experimentation reduced, as most firms were unable to continue reducing costs of mass production and to deliver the quality and creativity demanded by the top-end of international markets. A new LIS emerged whereby traders acquire knowledge on trends, designs and technologies from global buyers, after which traders and suppliers (primarily the traditional clustered firms; *ERG*) jointly develop new products that combine contemporary and traditional style elements (Fransen and Helmsing 2016a). The growth and innovativeness of the sector was held back by three factors: (1) Suppliers have a low level of absorptive capacity: they can't handle large orders, don't appreciate the relevance of new technologies and designs and have a weak organisational structure (*ERG*; Fransen and Helmsing 2016a). (2) Government support focuses on those small, clustered firms instead of on innovative traders (intervention L). It is seen as bureaucratic and inefficient (respondent #3, 10, 11, 13, 16). (3) The sector was hit by the Bali bombing in 2002 (reducing tourism), an earthquake in 2006 (killing people and destroying factories, houses and stock) and the financial crises since 2008 (reducing the market). As the actors jointly overcame the shocks, the crises strengthened the institutionalisation (*SEQ*).

*Contemporary LIS*: The LIS enables a medium-level of product and a low level of process innovation, whereby designers introduce product innovations which diffuses to the suppliers (*LIS.T*). The LIS still encompasses the traditional clusters (*ERG*), but these are now geographically swallowed up by Yogyakarta and economically connected to each other and global value chains. This results in an open LIS, in the sense that knowledge is acquired from a wide range of local and global sources and clusters are strongly embedded in local and local networks (event G; *OPE*). However, other aspects of openness are not that well developed, including a weak absorptive capacity of clustered firms and relatively weak institution building.

## Comparison

This section compares to what extent path dependence is able to explain the contemporary LIS of the three case studies, arguing that the LIS of Cape Town and Yiwu exhibit relatively strong path dependence, while the path dependence of Yogyakarta's LIS cannot be proven. Table 4 summarises the findings of the previous section and table 5 concludes to what extent path dependence is able to explain the contemporary LIS.

The research findings (table 4 and 5) show that all three case studies have contingency, indicated by initial chance events leading to the emergence of new institutions. These initial institutions have a strong ergodicity, as these still form the backbone of the LIS. Non-ergodicity is also indicated in all cases by a logical sequence of events. However, the LIS of Yogyakarta exhibits a lower level of non-ergodicity, because organisations and institutions are relatively weak and hence show less learning and adaptation. This also makes it hard to show local irreversibility. The third element of path dependence, inflexibility, is strongly indicated for the LIS of Cape Town and Yiwu. They have become inflexible and rigid over time. By contrast, the LIS of Yogyakarta is less set in stone, because sunk costs of clustered suppliers remained relatively low and relatively weak organisations and

institutions lead to weak externalities. That is not to say that the LIS is open: firms collect knowledge from many local and global sources, but weak capacities of the organisations and weak institutions limit the impact of firms to absorb knowledge. The LIS of Yogyakarta still remains weakly developed and it may simply be difficult to prove path dependence of a weakly developed LIS.

Finally, the effect of path dependence on the type and efficiency of LIS differs markedly between the three case studies. The LIS of Yiwu has a strong and by now unwanted focus on process innovation, because it has led to mass production and reducing profit margins in Yiwu. It is hard to explain why Yiwu's firms don't improve profit margins by innovating products on a larger scale, as neo-classical economists would expect. Based on the research findings, it appears that path dependence does a better job in explaining the contemporary LIS than neo-classical economics. By contrast, the LIS of Cape Town is still segmented and focuses on product innovation. These unwanted findings are also not easily explained by neo-classical economics. The LIS of Yogyakarta combines product and process innovation but has relatively weak institutions and actors. This finding can't easily be explained by increasing returns, as these are small, and might benefit from an analysis of the path dependence of governance systems instead.

*Table 4: summary of findings (number of relevant indicators/ description of their strength)*

Element of path dependence	Yiwu	Cape Town	Yogyakarta
Contingency (CON)	1/Bartering started at low cost and created institutions	1/Colonialism and apartheid created institutions of segmentation	1/Clustering of low tech creative industries created institutions
Non-ergodicity (ERG)	3/Quanxi networks and low cost production and trading remain the core of LIS. Firms learned and adapted as family businesses.	3/ Segmentation, with product innovation of formal firms and low capacities of informal firms is institutionalised.	2/ The local irreversibility is low, as organisations and institutions are relatively weakly developed.
Inflexibility: lock-in (LOC)	5/ Lock-in occurs across all indicators and confirmed by various means.	4/ Lock-in is deeply embedded in society. It occurs in most indicators, but sunk costs are low.	1/ Firms are locked in by weak absorptive capacities of clustered firms.
“” : openness (OPE)	2/Bit of openness recently	1/ New actors have been formed.	1/ Knowledge networks are open.
Sequencing (SEQ)	4/Reinforcing events are often indicated	4/ Two separate path ways are indicated	3/ The self-reinforcing sequence of events during phase 3 is relatively weak.
LIS type/openness (LIS.P)	2/Profits are decreasing, but firms continue as before	2/ Strong product focus of formal firms	0/ not proven
LIS inefficiencies (LIS.E)	1/Quanxi networks may lead to some system inefficiencies	2/ Segmentation and weak support for informal firms	3/ Weak organisations, institutions and capacities

*Table 5: Strength of path dependence (scale 1 to 3)*

		Yiwu	Cape Town	Yogyakarta
Contingency	CON	⊕ ⊕ ⊕	⊕ ⊕ ⊕	⊕ ⊕ ⊕
Non-ergodicity	ERG	⊕ ⊕ ⊕	⊕ ⊕ ⊕	⊕ ⊕
Inflexibility: lock-in instead of openness	LOC	⊕ ⊕ ⊕	⊕ ⊕ ⊕	
Sequencing	SEQ	⊕ ⊕ ⊕	⊕ ⊕ ⊕	⊕ ⊕
LIS type/market failure	LIS-P	⊕ ⊕ ⊕	⊕ ⊕	⊕
LIS inefficiencies	LIS-I	⊕	⊕ ⊕ ⊕	⊕ ⊕ ⊕
Unweighted average		2.7	2.8	1.8

Scoring: † variable is referred to; † † variable is regularly referred to; † † † variable is often referred to in various indicators and considered relevant (see table 4).

## Discussion

What can we learn from the case studies in relation to previous studies? Before I start, a word of caution is in order: the study only analysed three cases in low tech sectors, while developing countries have a rich institutional and sectoral diversity. Therefore, instead of generalising findings I compare my findings to previous studies and appreciate the need for more research.

First of all, the research findings show that path dependence from Arthur's perspective cannot explain the emergence of an institutionally weak LIS because these hardly create increased returns (see also David 2000). This finding shows a major hindrance in studying emerging LIS in developing countries, leading to the recommendation to consider path dependence as increased returns and as a path dependent governance system in studying weak and open LIS.

A second and related finding is that the study explains two closed LIS but phases more difficulty in explaining the weak, open LIS. This finding is in line with the argument of Liebowitz and Margolis (1990) that path dependence is particularly relevant in explaining third degree path inefficiencies and of David (2000) who argues that path dependence can only explain rare cases. While Pierson (2000) strongly opposes the first notion, I would like to refer to Williamson (1993) who argues that the behaviour of agents can often better be explained by their maximising behaviour. This is likely to offer an alternative explanation for first and (to a lesser extent) second degree path inefficiencies.

Third, I would like to connect my findings to the debate on the relevance of studies on the path dependence of LIS. Path dependence offers a retrospective perspective, which enables scholars and policy makers to appreciate how a contemporary institutional system has emerged and evolved. The analysis highlights the uniqueness of institutional systems and enables scholars and policy makers to appreciate the specific institutional comparative advantage of each territory. While such a retrospective perspective is relevant in itself, scholars tend to express relevance in terms of policy and the prevention of lock-in. Government policies may aim to remedy path inefficiencies by stimulating feasible, innovation-increasing alternatives (Williamson 1993: 140). Knowing and understanding inefficiencies of the LIS allows for policy development, though some inefficiencies may be irremediable due to the cost and effort needed to change institutional systems, networks and sunk costs (David 2000; Niosi, 2002; Williamson 1993). The case studies show the effect of some remedial policies: In Cape Town, the government aims to reduce segmentation and in Yiwu to increase product innovation. Both interventions prove to be expensive and time consuming, with limited success to date. However, possibly such niched institutional change might be upscaled at a later moment leading to path renewal (Geels 2004; Geels and Scott 2007; Martin and Simmie, 2008).

Various scholars discuss how a lock-in can be prevented. They note, among others, that governments can try to leave options open a bit longer, before they close down once again (David 2000), that LIS should learn and adapt (McKinnon 2009), that heterogeneous agents, technologies, institutions, groups, and networks are less likely to be locked-in (MacKinnon 2009) and that absorptive capacity and openness may prevent lock-in (Marin and Simmie 2008). Most scholars argue that regions can re-invent themselves. While I cannot confirm or falsify these notions, I can add a precondition. The Cape Town and Yogyakarta case studies show that learning and absorptive capacity should be balanced. Biased learning and competence building, that is: with an overly focus on either product or process innovation, may still lead to a lock-in.

## Conclusion

Scholars have argued that path dependence may be able to explain differences in types and (in)efficiencies of LIS in developing countries (Geels 2004; Martin 2010; Martin and Simmie 2008; Martin and Sunley 2006; Niosi 2002; Scot and Geels 2007; Strambach 2010). But while scholars have greatly contributed to this emerging field of study, empirical prove has remained relatively thin. This study has operationalised path dependence of LIS and assessed three small case studies of low tech sectors in developing countries. It draws three conclusions.

First, the study confirms that LIS which are open are less prone to end up with an inflexible and rigid institutional system (Martin and Sunley 2006). This study adds to existing literature that the knowledge network should expose firms to knowledge on both products and processes. If institutional systems only expose firms to one of the two, then it may lead to a lock-in nonetheless, as illustrated by the cases on Yiwu and Cape Town.

A second conclusion is that path dependence may be able to explain a lock-in of LIS in developing economies, but it appears to be less able to explain inefficient or open LIS. This finding is in line with Liebowitz and Margolis' (1990) argument that path dependence can only be proven for third degree path inefficiencies. Reasons are that weak and open LIS are more flexible and its sequencing of events is therefore not always self-reinforcing. Open LIS are likely to score below par on two of the variables of path dependence: inflexibility and time sequencing. It is relevant to identify the specific, albeit context-specific mechanisms leading to a lock-in, in order to look for remedies (Williamson 1993).

A third conclusion is that process tracing is a useful research tool to unearth the initial, critical and minor events that form the history of the LIS, as already applied in sociology (Mahoney 2000). This research methodology enables scholars to describe and analyse the sequence of events as well as the contingency and non-ergodicity of the LIS. It therefore complements the growing body of literature on the inflexibility and lock-in of LIS focus and thus creates a more comprehensive picture of the path dependence of LIS.

The conclusions lead to the following research recommendations. First of all, I recommend more research on the emergence of LIS in developing countries, as we don't yet fully understand why and how LIS emerge. It is not enough to argue that a chance event may lead to an LIS; it is worth knowing how chance events lead to LIS in concrete cases and what mechanisms are at work. This requires more detailed studies of the initial stages of LIS. Second, I recommend comparative case studies in order to place the level of path dependence into perspective. Finally, I recommend to continue linking theory on path dependence to that of openness versus lock-in, as the two fields of study are complementary.

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