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Qualifying Innovation in the Hall-Soskice *Varieties of Capitalism* Framework – Beyond Incremental and Radical

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Content

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List of Acronyms

CMEs	Coordinated Market Economies
DMEs	Dependent Market Economies
FDI	Foreign Direct Investment
GHG	Greenhouse Gas
HMEs	Hierarchical Market Economies
IEA	International Energy Agency
LMEs	Liberal Market Economies
MMEs	Mixed Market Economies
MNCs	Multinational Corporations
NBER	National Bureau of Economic Research
NIS	National Innovation Systems
NMEs	Network Market Economies
OECD	Organization for Economic Co-operation and Development
R&D	Research and Development
SPIS	Science Policy and Innovation Studies
SPRU	Science Policy Research Unit
VoC	Varieties of Capitalism

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Executive Summary

Innovation research, interested in understanding the mechanisms behind the discovery and survival of new products and services, is a young science still feeling its way in the vast academic world. It has frequently fascinated researchers of other fields who have tried to integrate its ideas and concepts into their own studies. The institutional framework called Varieties of Capitalism (VoC) is no different and its analysis of the differences among developed economies led to the hypothesis that Coordinated Market Economies (CMEs) adopt incremental innovation patters while Liberal Market Economies (LMEs) prefer radical innovation patterns. Yet, this dichotomy has not been without severe criticism, leaving a void as to how to better qualify innovation practices among modern capitalist economies.

This paper attempts to go beyond these limitations. It uses recent innovation indicators pertinent to the VoC framework to establish what type of innovation practice is preferred by a particular type of capitalist organizational model. It will focus on the clean technology sector in order to better understand the differences between the different types of economies. It will be shown that CMEs opt for strategies that focus on applied research and strong technical/vocational education that allows technological breakthroughs to seep into the economy through existing business structures and/or by way of strong government regulation. LMEs, on the other hand, manage to structure their institutional landscape towards strengthening the main drivers of technological discovery and diffusion, thanks notably to efficient government support measures. The playing field these measures create allow for fluid business structures where entrepreneurial start-ups can thrive and disseminate technological breakthroughs throughout the economy.

Introduction

In 2001, Peter A. Hall and David Soskice took the academic world by storm. Their book *Varieties of Capitalism – The Institutional Foundations of Comparative Advantage* posited that modern capitalist economies organize themselves in two distinct types: Liberal-Market Economies (LMEs) and Coordinated-Market Economies (CMEs). The difference between the two stem from the solutions found in solving coordination problems between economic actors: markets for LMEs and sector or economy-wide decision making instances for CMEs. Through self-reinforcing mechanisms, institutions in these two types of capitalist organizational models are pretty solid and change only very slowly. Furthermore, each of these types of economies holds particular competitive advantages over the other with LMEs better apt to compete in biotechnology, microelectronics, corporate finance or entertainment, and CMEs more proficient in sectors such as machine tools, factory equipment, specialized transport equipment or consumer durables.

Research Question

The Varieties of Capitalism (VoC) approach argues that innovation practices differ among countries according to their respective comparative institutional advantages. While firms that carry out radical innovation face a competitive edge in LMEs, the opposite is true for firms specialized in incremental innovation, which find themselves better able to survive in CMEs. Since qualifying innovation as of either one type or another holds many limitations, a promising avenue of research deals with whether or not it would be possible to provide greater depth to this issue without sacrificing the basic tenants and approach of the theoretical framework.

To do it in a comprehensive and extensive manner would, obviously, be a Herculean task. The original paradigm would need to be deconstructed, while new elements are introduced in order to deduce a more profound view of innovation. Rather, we embark on a much less grandiose journey and propose to use recent data, with a special emphasis on those indicators important to innovation analysis, to establish groupings of countries as if we were empirically testing the theory

from one single angle. In this sense, national "types" of innovation systems can potentially be identified, while keeping true to the original Hall-Soskice framework. In other words, our research questions are:

1. Do the different capitalist organizational types as proposed by the Varieties of Capitalism approach hold true when innovation is explicitly considered in the segmentation data?
2. What can we further conclude when innovation becomes the core of the research matter?

1. Innovation on a National Scale

1.1 Introduction to Innovation

The Merriam-Webster online dictionary defines innovation as: 1) the introduction of something new; or 2) a new idea, method, or device (synonym of novelty). Yet, its colloquial use hints that the term has gained a mystique of its own, being tirelessly repeated by marketing specialists, policy makers, business gurus and social scientists as a recipe for all woes. It embodies the new, the adventurous, the better, the bold and the positive.

How then can we capture, let alone analyze, a concept with so many different facets and with such broad application that it is slowly being emptied of any real meaning? Insofar as innovation represents change, a theory (or theories) of innovation represent a theory of everything and, as such, devoid of much practical or theoretical use (Moldaschl, 2010). After all, everything changes either continuously or erratically.

It is only by limiting the field of enquiry and using a limited set of tools that innovation study can be called study in any real sense of the term. It is exactly this process that generations of researchers have attempted. Their success can in part be gauged by the fact that their enquiries have, in many ways, shaped our colloquial and modern definition of the term.

Defining the science that studies innovation is not an easy task and, following Martin (2012), we borrow the definition used by the journal *Research Policy*, one of the leading publications in the field. Science policy and innovation studies (SPIS) are "devoted to analyzing, understanding and effectively responding to the economic, policy, management, organizational, environmental and other challenges posed by innovation, technology, R&D and science. This includes a number of related activities concerned with the creation of knowledge (through research), the diffusion and acquisition of knowledge (e.g. through organizational learning), and its exploitation in the form of new or improved products, processes or services" (Martin, 2012, 1220).

Godin (2012) argues that innovation studies are concerned with the commercialization of technological inventions and approach the problem through the introduction of en entirely new framework based on four pillars: 1) it is institutional in focus, with a clear preference for descriptive rather than mathematical tools; 2) it studies both product innovation and process innovation; 3) it is very much concerned with policy; and 4) it holds technological innovation as the essential boundaries of the field.

Martin (2012), on the other hand, prefers to consider innovation studies as the amalgam of concepts and tools that have gained a life of their own, independent of the fields from where they originally came from. Innovation studies adopts components of economics (e.g. neo-Schumpeterian and evolutionary economics), economic and business history (e.g. the relationship of technology to industrial development), political science (e.g. diffusion of technology through policies) management (e.g. new product development), organizational studies (e.g. resource-based view of the firm) and sociology (e.g. diffusion of innovations).

Regardless of the way in which researchers attempt to define the boundaries of this nascent field, one thing is certain. Despite its ties to existing disciplines such as economics, sociology or management, innovation studies is an independent academic subject with various vibrant communities of scholars, discussion forums and specialized publication. All these elements betray common sets of research tools and questions, methods of study, objects of study and hypothesis, which

taken together form the basis of innovation science (Fagerberg and Verspagen, 2009).

1.2 History of Innovation Studies

One the fathers of innovation studies, Joseph Schumpeter, saw innovation as the driving force of economic progress to the point where both could readily be two sides of a single concept. "What we, unscientifically, call economic progress means essentially putting productive resources to uses *hitherto untried in practice*, and withdrawing them from the uses they have served so far. That is what is called 'innovation". (Schumpeter, 1928, 378).

He classified innovation within five different activities: new products, new methods of production, new sources of supply, the exploitation of new markets, and new ways to organize business. The entrepreneur gained the center stage and, while at the beginning the author focused his attention on the individual (Schumpeter Mark I), he eventually highlighted the importance of large firms to this process (Schumpeter Mark II). (Fagerberg, 2005).

Yet, innovation cannot be reduced to the work of a single economic actor. Within the stable circular flow of money and goods, productive resources cannot be relocated to new uses by the sheer force of will of entrepreneurs. This relocation requires capital at the hands of financial agents, hence the importance of credit-creation for Schumpeter's whole theoretical framework (Schumpeter, 1928). Early on, the complexity in innovative processes was identified and, as more researchers added to the body of work, it soon became clear that innovation on a national or regional scale depended on the interaction of a multitude of actors.

While it is tempting to see a continuous progression of thoughts, discussions, research and insights from a few forefathers (as identified in Martin, 2012) such as Joseph Schumpeter, William Fielding Ogburn, Vannevar Bush and Homer Garner Barnett to modern scholars, the truth is much more complex (Godin, 2012). Innovation studies are the result of two different "traditions", one American and the other European.

The American tradition owes its symbolic start to the 1960 conference organized by the National Bureau of Economic Research (NBER), which counted among its participants Simon Kuznets, Jacob Schmookler and Kenneth Joseph Arrow (Godin, 2010). Behind the conference, lay the wish to use quantitative economic tools and models, especially those centred on the concept of efficiency, to explain technical invention. Later scholars eventually build up from the insights discovered and slowly veered towards the study of technological change through the prism of the economists' production function. Lately, researchers of the American tradition, mostly mainstream economists, have realized that innovation studies have gained a life of their own (thereby augmenting the profile of institutional economics) and have sought to offer a counterpoint to this process by amending their models to peer, for instance, into commercialization efforts (Godin, 2010).

The European tradition owes its symbolic start to the creation of the Science Policy Research Unit (SPRU) at the University of Sussex (Fagerberg and Verspagen, 2009) and Chris Freeman's work in the 1970s, especially the book *The Economics of Industrial Innovation* published in 1974 (Godin, 2012). There, the basic building blocks of this particular field of enquiry were put in place, and so influential were he and later researchers who followed in his footsteps that they managed to create an entirely new discipline, one which is now known as innovation studies. Its dominance over the other tradition likely lies in the appropriation of the term "innovation" as its particular field of study. The interactions between scholars of this tradition and influential policy makers further legitimized it as the sole theoretical base for the field (Godin, 2012).

Of course, competing scholarly traditions are not complete without some form of personal drama. An interesting example comes from the story of William Rupert Maclaurin who is a precursor to much early thinking in innovation (including the linear model of innovation), but has been forgotten in our modern times (Godin, 2008). His suicide in 1959, oftentimes attributed to the lack of appreciation of his work in the MIT economics department, is a cruel reminder of how chaotic the search for an understanding of our world can be.

Irrespective of how one sees the development of innovation studies, one thing remains clear. Our understanding of innovation has clearly broadened and one way of illustrating this is the evolution of government support policies. Following the Second World War, government officials saw innovation as the concrete result of the generation of knowledge. Supporting universities, research centres and the like, it was argued, would allow economic progress through the accumulation of knowledge capital. The difficulties in making the jump from "pure" to "applied" knowledge was eventually identified and more targeted sectoral support policies were enacted beginning in the 1970s. With the shortcomings in trying to control technological development paths, interaction between economic actors gained centre stage around the 1990s and it was understood that a systemic look was necessary in order to foster more innovation. This transition from science, to technology, to innovation policy in the second-half of the 20th century illustrates how our understanding of innovation moved from the atomized entrepreneur and the government provision of public goods to the support of the multitude of relations within an economic system (Lundvall and Borás, 2005).

1.3 Qualifying Innovation

Humanity has always had an inherent desire to categorize everything around it and innovation studies are no exception. Nonetheless, there doesn't seem to be a universal acceptance of how to fit innovation practices into neat little boxes. Martin (2012) states that innovation was categorized in either incremental or radical up to the end of the 1980s, a dichotomy which still influences researchers and practitioners to this day.

Incremental innovation "introduces relatively minor changes to the existing product, exploits the potential of the established design, and often reinforces the dominance of established firms" (Henderson and Clark, 1990, 9). It entails "continuous, but small-scale improvements to existing product lines and production processes" (Hall and Soskice, 2001, 39). Radical innovation, on the other hand, "is based on a different set of engineering and scientific principles and often opens up whole new markets and potential applications (…), [creating] great difficulties for established firms (…) and [being the basis] for the successful entry of new firms or even the redefinition of an industry" (Henderson and Clark, 1990,

9). It entails "substantial shifts in product lines, the development of entirely new goods, or major changes to the production process" (Hall and Soskice, 2001, 39-40).

Yet, starting from the 1990s, the scope has broadened somewhat (Martin, 2012) with researchers introducing novel concepts such as modular or architectural innovation (Henderson and Clark, 1990) or disruptive innovation (Christensen, 1997). In many ways, the scope of analysis will determine how one sees innovation. Schumpeter, for instance, opted for a view on the end-result, identifying 5 types of innovation: new products, new methods of production, new sources of supply, the exploitation of new markets, and new ways to organize business (Fagerberg, 2005). Moore (2008), on the other hand, prefers to look at innovation through the company life-cycle, identifying 14 different types: disruptive innovation, application innovation, product innovation, platform innovation, value engineering innovation, line extension innovation, enhancement innovation, integration innovation, marketing innovation, process innovation, experiential innovation, value migration innovation, organic renewal and acquisition renewal. Chesbrough (2003), as a final example, considered how companies manage internal/external resources, coining the terms closed and open innovation (see table 1 for a few more details).

While these concepts have been successfully applied at firm level, qualifying patterns and characteristics of innovation processes country-wide is notoriously difficult, not least of which due to the sheer complexity found in modern economic systems. Some have opted for distinguishing between technology producing countries and catching-up countries, noting how institutional deficiencies in the latter can explain poor innovative performance (see, for instance, Intarakumnerd, Chairatana and Tangchitpiboon, 2002, for the case of Thailand).

Table 1 – Different ways to qualify innovation: some examples

Innovation through different lenses	Some examples
Basic dichotomy	• **Incremental:** small changes in products or services • **Radical:** large changes in products or services

Through end-result	• **New products** – ex.: iPod • **New methods of production** – ex.: assembly line • **New sources of supply** – ex: deep-sea oil • **Exploitation of new markets** – ex.: rising middle class in emerging economies • **New ways to organize business** – ex.: Just-in-time management
Through the company life cycle	• **Application innovation:** finding and exploiting a new use for an existing technology • **Line extension innovation:** new offerings within an established product or service that targets customers' unique preferences • **Integration innovation:** integrate a series of separate and established products into one offering • **Value migration innovation:** transfer of focus from a value-losing element to a value-gaining one (ex: from products to service) • **Organic renewal:** migration of resources from a declining category to a growing one, usually through in-house R&D
Through knowledge management	• **Closed innovation:** innovation carried solely with internal resources • **Open innovation:** innovation carried out with substantial cooperation from outside resources
Other forms	• **Architectural innovation:** change in the links of components of a product, while leaving the core design concepts unchanged (ex.: change in delivering software, from CDs to online downloading) • **Modular innovation:** change in the core concepts of a product, while leaving its major components unchanged (ex.: change from analog to digital phones) • **Disruptive innovation:** process by which a product or service starts in simple applications and then moves up market, displacing established competitors

Others, as we will see below, preferred to capture the most prevalent innovation processes (usually within a dual approach, such as incremental and radical innovation). Still others, as we will see in chapter 3, have bypassed qualification schemes altogether, favouring qualitative or quantitative comparisons based on a fixed set of indicators.

1.4 Innovation from an Institutional Perspective

Institutionalism, in its many different forms, has held a long interest in the evolution and development of technical, product and process innovations (Werle, 2012). Their efforts have given birth to 3 distinct streams of research: 1) socio-economic institutionalism in the form of National Innovation Systems (NIS); 2) techno-sociological institutionalism, which tend to focus on large technological systems; and 3) politico-economic institutionalism, such as the Varieties of Capitalism approach.

Socio-Economic Institutionalism

NIS attempt to capture "all important economic, social, political, organizational, institutional, and other factors that influence the development, diffusion, and use of innovation" (Edquist, 2005, 182). It adopts a more holistic approach with a focus on organizations (formal structures consciously created towards a common purpose) and national institutions (the set of common habits, norms, routines, laws and established practices). Profound interaction between the different actors, especially among users and producers (Lundvall, 1988), as well as the inherent complexity of innovation processes (e.g. chain-linked model of Kline and Rosenberg, 1986), are explicitly considered in the framework.

While it does capture the complexity in innovation processes, qualifying the results of different types of innovation has not been the subject of much research (Werle, 2012). The first distinction, between seldom and frequent innovation, measures how well the different institutions coordinate among themselves. Patents are particular useful for this endeavour, given the rising trade in technology since the 1990s (Arora, Ceccagnoli and Cohen, 2007). The second distinction, between incremental and radical innovation is also noteworthy, but usually within a long-term logic of techno-economic paradigms, periods characterized by a dominance of specific "generic technologies with nearly all-pervasive applicability" (Perez, 2002, 16) and a series of common-sense innovation principles. For instance, the *Age of Oil and the Automobile* (1908-1974) was shaped by mass-production of automobiles and household goods, standardization of products, universal

electricity, an ever-increasing network of roads, highways, port and airports, among others (Perez, 2002).

Techno-Sociological Institutionalism

Contrary to the other two, techno-sociological institutionalism tries to provide a more detailed examination of technology and its respective stages of development. It is concerned, first and foremost, with how large and complex technological systems, such as the internet, were created, grew and eventually became dominant. Within this evolution, the interplay between technology and institutions are of a particular interest to this stream of research, especially when it comes to the different forms of governance: market, hierarchy and networks. Innovation networks have lately risen to prominence in the research agenda (despite having been "discovered" much later in academic research) because of its perceived advantages over the other two forms of governance. Based on trust and negotiation, networks allow actors to better manage uncertainty in response to market failures and to counteract the inflexibility found in hierarchies. Within this view, structural innovation can be of one or more of four different dimensions. It is conservative in stable environments where firms or government internalize all aspects of system development. It can be radical when spurred by changes in the political-institutional environment (such as after deregulation). It can also be compatible or incompatible depending on the support structure in which the innovation occurred (Werle, 2012).

Politico-Economic Institutionalism

The final stream has a particularly strong focus on national boundaries and characteristics and is the focus of this research thesis. While innovation systems can be used on different scales, from regional to international, researchers within politic-economic traditions prefer to keep a national focus and are particularly interested in institutional differences between countries and how they explain variations in economic performance. The Varieties of Capitalism (VoC), which will be extensively dealt with in the next chapter, is one such approach, but others do exist as well. While they may diverge on various issues, many of the themes are repeated in different approaches, notably the wish to find and describe the

various forms of capitalist organizations, understand their resistance to exogenous shocks and analyse convergence/divergence logics between them.

Regulation theory, for instance, stresses the existence of 4 different types of capitalist organizations: market oriented (commercial logic is the organising principle for almost all exchanges); meso-corporatist (solidarity and mobility are the rules found in dominating economic units that are large in size and diverse in output); statist (economy is highly influenced by public policies in areas like production, demand, and institutional codifications); and social-democratic (actors negotiate the rules governing most aspects of society and the economy). This categorization is the result of 5 institutional forms – form of competition, monetary regime, relationship between the state and the economy, and insertion within the international system – with special emphasis on endogenous historical changes and social and political conflicts (Boyer, 2005).

Another particularly appreciated distinction was proposed by Whitley (2000). He identified 6 types of capitalist economies and attributed to each a dominant firm type and a subsequent logic for innovative practices.

- *Fragmented:* characterized by low integration throughout the value chain, a multitude of small companies and exchange carried in competitive markets with strong fluctuations. The dominant firm type is opportunistic, pursuing new opportunities as they appear without commitment to any one type of industry, set of skills or even core competency;

- *Coordinated industrial district:* characterized by a multitude of small and medium firms with a high rate of failures and start-ups. They remain autonomous decision makers, although try to organize themselves for bulk buying and information exchange practices. The dominant firm type is artisanal where reputation is important and success depends on the skills of individual workers and their capacity to organize themselves on the shop floor. Italian industrial districts exemplify this type of coordination;

- *Compartmentalized:* characterized by a dominance of large firms with complex decision-making and bureaucratic processes and that do not

readily engage in any form of long-term alliance. To a certain extent, these large firms, called isolated hierarchies, represent seas of order in the chaos which is the market, much like a Chandlerian firm in a lightly regulated Anglo-Saxon economy;

- *State organized:* similar to compartmentalized capitalism, but where the state is ever present either through direct ownership or through indirect control by subsidized credit by state-owned banks or by interpersonal relationships between business owners and influential government members. The Korean and post-war French states exemplify this type of organization, where state-dependent firms are dominant and characterized by centralized control, close task supervision and wide-ranging top-management decision-making control;

- *Collaborative:* characterized by high levels of ownership integration and strong inter-firm linkages. In these systems, the state encourages the development of intermediary associations that are responsible for an extensive coordination mandate in economic and social relations. Cooperative hierarchies are the dominant firm type where authority is shared among business partners and there is extensive employee involvement. Germany is an example of such a system;

- *Highly coordinated:* is a deeper form of collaborative system where alliances and cooperation are much more institutionalized, activities across industries are more integrated, new developments are coordinated among a group of firms, and the state plays a more directing role. Allied hierarchies differ from cooperative hierarchies in that there is a greater discretion of middle-level managers to assign jobs and tasks, and shift workers between roles, workplaces and business units. Post-war Japan is an example of such a system.

In conclusion to this quick overview of existing theoretical frameworks, it is important to highlight that innovation has not been the subject of much analysis. Despite the richness in explaining interactions within these different modes of

capitalist organizations, like before, the basic distinction between radical and incremental innovation was maintained. (Werle, 2012)

2. The Varieties of Capitalism Framework

2.1 A Short History

Comparative politico-economic analysis has a rich tradition in the academic world. For almost two centuries now, scholars have been interested in understanding the differences between nations' political and economic institutions in the hopes of answering a varied array of questions. As explained in Hall and Soskice (2001), these questions can be related to economic policy (e.g. what "right" policies should be implemented to improve economic competitiveness?), firm strategy (e.g. do firms exhibit persistent variations in the strategies they adopt across different regions of the world?), economic performance (e.g. do some institutions provide lower rates of unemployment and inflation than others?), and even technological development (e.g. will worldwide technological diffusion through globalization lead to convergence in the international competitive landscape?). The answers obviously are as diverse as the researchers who study them.

Following the end of the Cold War and the collapse of the Soviet Union in 1989, increased attention has been given to diversity within capitalist economies (Kang, 2006). This is not to say that comparative analysis were absent before this time. Rather, researchers were mostly concerned by the differences between capitalist and socialist economies (Nölke and Vliegenthart, 2009).

Some researchers adopted a more Weberian approach highlighting patterns of legitimate authority and dividing countries according to a variety of dimensions, such as the means of owner control, the extent of integration of industrial sectors through ownership or the extent of employer-employee interdependence. Others opted instead to analyze the various mechanisms of governance, focusing on markets, hierarchies, social networks, community norms, associations and state intervention and moving progressively away from national typologies in favor of sectoral viewpoints (Jackson and Deeg, 2008).

A third group of scholars embarked on parallel research agendas which jointly came to be known as the Varieties of Capitalism (VoC) approach (Kang, 2006). Yamamura and Streeck's *The End of Diversity? Prospects for German and Japanese Capitalism* (2003), Schmidt's *French Capitalism Transformed, Yet Still a Third Variety of Capitalism* (2003) or Amable's *The Diversity of Modern Capitalism* (2003) are all examples of this.

While researchers of this last trend contributed extensively to our understanding of modern capitalist economies, none reached the level of influence of the book *Varieties of Capitalism – The Institutional Foundations of Comparative Advantage* (2001), edited by Peter A. Hall and David Soskice. Their work took the academic world by storm and soon was subject to an impressive amount of both praise and criticism (Kang, 2006).

It was followed in 2007 by *Beyond Varieties of Capitalism: Conflict, Contradictions and Complementarities* (2007), edited by Bob Hancké, Martin Rhodes and Mark Thatcher, which improved the basic framework and addressed many of the criticism brought against it.

2.2 VoC as a Response to Existing Analysis

The VoC approach is an attempt to go beyond three important theoretical frameworks. The first is the so-called *modernization approach* which saw the state as a fundamental driver of economic growth thanks to its capabilities to plan industrial modernization and force them upon key sectors of the economy. The second is the *neo-corporatist* point of view which defended the advantages of centralized and state moderated negotiations between employers and employees. The final influence is the *social systems of production* approach which stresses the importance of regional factors in economic growth given institutions' ability in generating trust and enhancing learning, the backbones of technological innovation. All of these agendas focused on those elements deemed fundamental to explain differences in economic success, hence better qualifying recommendations to decision makers.

Much in the same way, the VoC approach seeks to explain why economic differences persists in our modern world and why economies are still structurally different despite this new modern wave of globalization. It differs from the three above due to its interest in strategic interactions between economic actors, notably the firm, center of the analysis (Hall and Soskice, 2001).

2.3 The Varieties of Capitalism Approach

Institutional Complementarities

At the heart of the VoC approach, lies the concept of institutional complementarities (Kang, 2006). In economic spheres, goods are said to be complementary if a price rise of one of them causes a depression of demand in the other. As such, bread and butter are complementary if a rise in the price of bread causes a decrease in the demand for butter.

Taking this analogy one step further, Hall and Soskice (2001) argue that institutions can also show elements of complementarity in the sense that the strengths found in one institutional sphere would influence the characteristics of other institutions found in a different sphere. For example, let us consider labor markets.

In the presence of financial markets that can easily[1] transfer resources from one endeavor to another, fluid labor markets may be more effective in maintaining low levels of unemployment than less fluid ones. This is because, in the former situation, labor can adapt to demands from financial capital by moving easily from one job to another. In an opposite situation, rigidities in the labor market would generate an inefficient equilibrium. Companies would not be able to easily adjust their level of manpower to changes in the market, worsening wage differentials between workers (as high-demand sectors continuously increase salaries to attract employees) and increasing unemployment.

[1] The reader should be advised that the examples presented in this section do not suppose a causality chain. Furthermore, the VoC approach highlights the relationship between all sub-systems, not the primacy of one over the other. The illustrations are therefore simplified in order to better convey the relations between different institutional spheres.

This situation is reversed when we consider an economy in which financial markets cannot easily move resources from one endeavor to another. Contrary to the above, fluid labor markets are comparatively at a disadvantage over rigid ones notably because of "poaching" activities between firms. As it becomes easy to hire trained employees in the market place, firms have little incentives to invest in new workers as these can easily move to another firm. The resulting equilibrium is a situation of high unemployment with a high contingent of people lacking proper job skills.

Nonetheless, should labor markets be more rigid, firms would be able to "capture" those competitive advantages stemming from employee training, as there would be little risk of losing them to competing firms. This optimal equilibrium is therefore one of lower unemployment with a higher overall skill level.

What is interesting to note is that these complementarities force the whole economic and social system to act in unison. Coming back to our labor market example, we can say that fluid financial markets will, to a certain extent, influence the development of more fluid labor markets. Institutional actors (governments, firms, unions, etc.), faced with the problems arising with rigid labor markets, will attempt to liberalize them further. This liberalization will then open new opportunities for financial markets to reap the benefits of more liberal labor markets which will then be liberalized even further to gain the benefits of increased financial activity and so forth. The whole system will move towards an equilibrium of near unrestricted labor and financial markets.

Should financial capital exhibit tendencies to be less moveable, the whole situation may be quite different from the above. Companies, safe from the threat of financial capital quickly drying up as a result of short-term losses, will invest more heavily in employee training. They will pressure for more rigidity in the market to extract as much benefits as possible from their investment. This qualified workforce will not seek to jump from one company to another in search of better opportunities because wages will tend to be uniform across sectors in the economy. As a result, they will pressure for sustaining the *status quo* where financial capital becomes less mobile. The resulting equilibrium is one of "patient capital" with more rigid labor markets.

With the economic and social sub-systems (the financial system, labor market, training system or inter-firm relations) interacting with each other on a continual basis, strengths become self-reinforcing. Much like the theories of competitive advantage in trade, economic institutions within a single economy will mold the capitalist organizational logic towards certain defined models. This comparative institutional advantage enhances the survival chance of the system as a whole producing distinct adjustments path to internal or external shocks (Kang, 2006).

The 2 Basic Types of Capitalist Organization Models

Hall and Soskice (2001) argue that this self-reinforcing logic forces economies to adopt one of two different "models": Coordinated Market Economies and Liberal Market Economies. The distinction is not limited to the traditional "less state intervention" and "more state intervention" (Taylor, 2005). On the contrary, by considering the firm and its strategic interactions within the prevailing socio-economic system as the main locus of analysis (Hall and Soskice, 2001), the VoC approach manages to put the firm as the fundamental actor in the economic landscape. The issue is not how the state can or does influence economic outcome, but rather how firms overcome the coordination problems found in modern economies.

Coordinated Market Economies

Coordinated Market Economies (CMEs) approach coordination problems through non-market solutions such as sector-wide consensus-building and negotiations (Hall and Soskice, 2001). Financial institutions, the lifeblood of any economic system, are geared towards providing long-term support for companies. Short-term fluctuations in the market valuation of companies are not as important as other non-divulged information of company robustness and future profitability.

This form of "patient capital" allows firms to retain skilled personnel and concentrate on long-term projects, while requiring alternative forms of feedback to evaluate medium and long-term success in the marketplace. Dense networks of financial and management actors therefore develop in order to satisfy this particular requirement.

But these networks span a much broader spectrum than just financiers and top management. With companies concentrating on long-term projects, skilled employees must be kept within company structures and not be "poached" by competitors. Government supported training schemes, homogeneous within the different sectors of the economy, and restrictions to the easy passage of employees from one firm to another minimize these occurrences. Faced with low risks of losing talented employees, companies can provide in-house training programs, further cementing the relation between employer and employee.

With such dense networks at play, top management is constrained from making unilateral decisions, consensus being the order of the day. This consensus though surpasses company boundaries as can be seen by how technology spreads in the economy. With the help of public and semi-public institutions and research centers that identify problems and seek industry-wide solutions, knowledge and technologies are diffused throughout the economy in a much more collaborative way.

Germany: A Typical CME

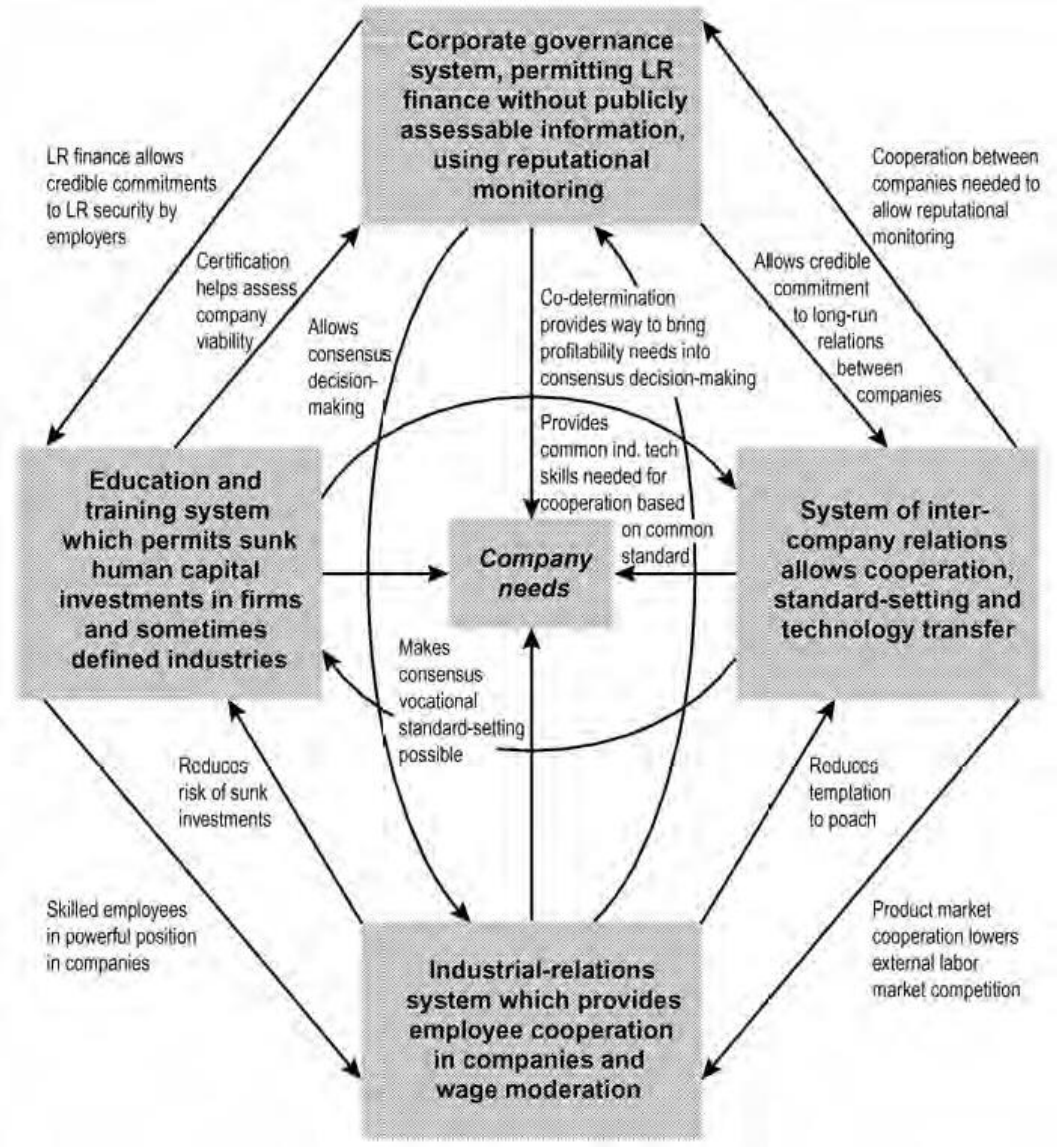
Germany is the "model" of a CME. Like the figure below shows, all 4 subsystems (finance, education/training, employee-employer relations and inter-company relations) are inter-dependent and mutually reinforcing. The education and training systems are publicly subsidized and rely on industry-wide employer associations and trade unions to supervise it. In essence, the system is geared towards providing company-specific skills to employees given technical standardization across sectors and the low risk of poaching between firms.

This generates a strong unity between employees, allowing them to better negotiate working conditions or wage levels with top management, towards a consensus that suits both parties. Reflecting industry-level negotiations between trade unions and employer associations, employees at the company level organize themselves in work councils with considerable authority over layoffs and working conditions.

This level of stability within companies allow financial actors to provide long-term financing, relying on reputational monitoring in dense cross-sectoral

networks of financial and company actors rather than publicly available financial information. This is guaranteed through: 1) the close relationships between major suppliers and clients; 2) the extensive networks brought about thanks to cross-shareholding in the economy; and 3) membership in active industry associations that gather information about companies while coordinating standard-setting, technology transfer, and vocational training.

Figure 1 – Institutional complementarities in the German economy



Source: Hall and Soskice, 2001

With a long-term view dominating the access to finance and consensus building as a core element to relations between employers and employees, companies within specific sectors can cooperate on standard-setting and technology transfer, knowing that competition will take certain determined forms. The risk of

technological breakthroughs that erode company value will be minimized as the company will likely be participating in their development.

Liberal Market Economies

On the opposite side of the scale, lie the Liberal Market Economies (LMEs) which approach coordination problems through market interactions (Hall and Soskice, 2001). With less institutional support for non-market solutions, companies must rely instead on robust markets to acquire a variety of resources (including technology, knowledge and trained employees) in order to compete effectively. Contrary to what happens in CMEs, financial actors are much more sensitive to short-term fluctuations in share prices and other indicators of market valuation. Mergers, acquisitions and hostile takeovers are tolerated as means to change management practices, overcome weaknesses and guarantee an adequate return on investment.

With constant pressure to maintain high profitability levels, top management is encouraged to risk aggressive strategies based on the introduction of new products or services. With fluid labor markets, employees have little or no say in company strategy and have much difficulty in opposing disruptive change to their work environments. Once redundant, they will seek to find employment in other companies, a process facilitated by the particular skill sets they possess. Contrary to what happens in CME economies where industry and firm-specific training is abundant, LME provide general skill training which can be applied throughout different industries (Estevez-Abe, Iversen and Soskice, 2001). It is precisely this fluidity which allows knowledge and technologies to diffuse throughout LME economies. With industry-wide research efforts much less pronounced, companies rely instead on their employees to accompany advances in the technological levels of their industry (Hall and Soskice, 2001).

The United States: A Typical LME

The United States is the model LME. Like Germany, all 4 institutional subsystems are mutually reinforcing and inter-dependent. The education/training system provides employees with general skills applicable in a variety of work environments. This takes the form of "certification" in general proficiencies (e.g.

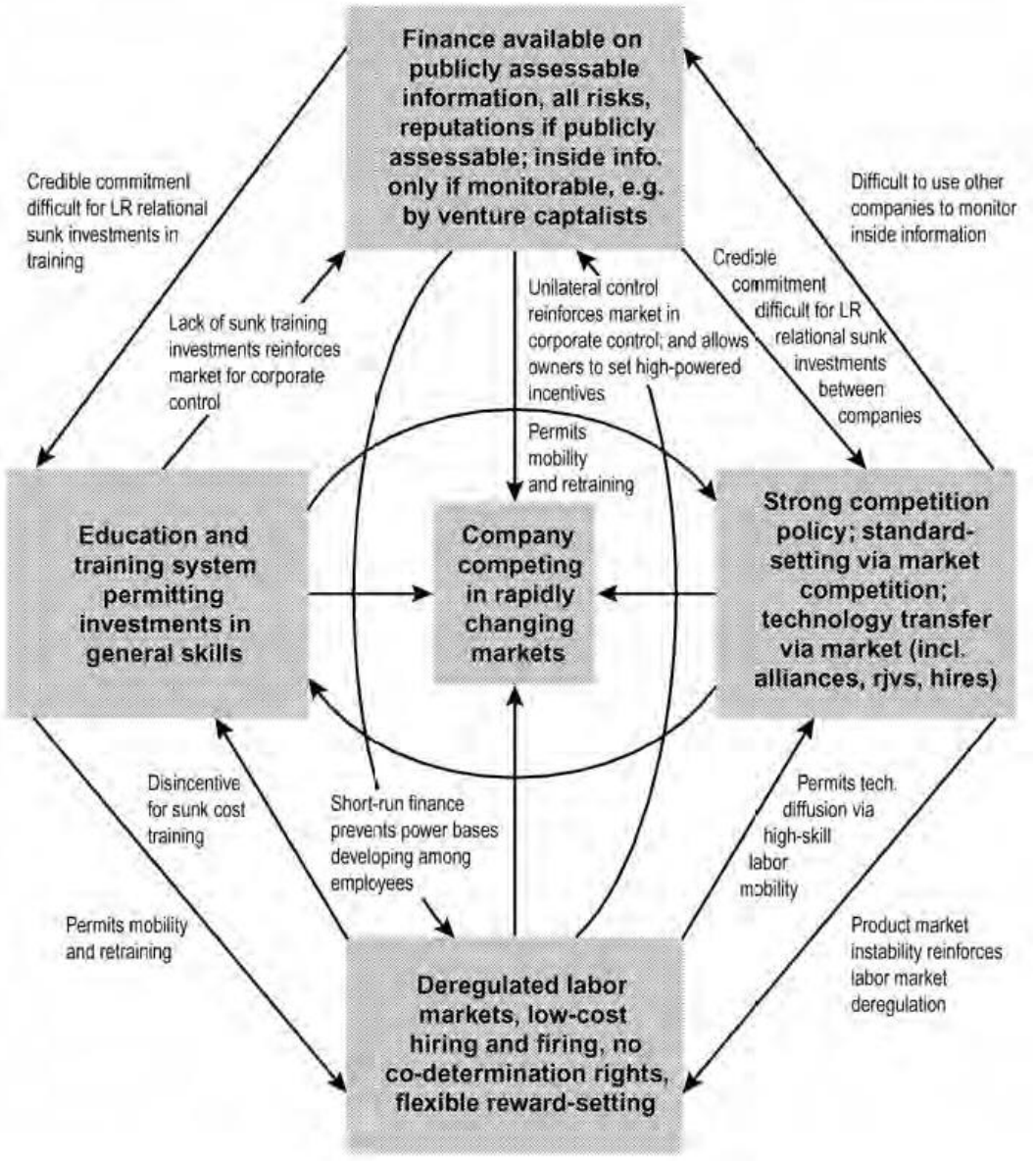
Project Management Professional (PMP)® offered by the Project Management Institute) rather than the acquisition of more specialized competencies.

Safe in the knowledge that their skill set is easily adaptable, employees do not develop long-term relationships with employers, preferring instead those companies that provide better wages or working conditions. Reflecting this fluidity, top management usually has unilateral control over the firm, including substantial freedom to hire and fire. They are under no obligation to have representative bodies for employees and are less "threatened" by trade unions (with exceptions for a few sectors).

All of these elements are further reinforced by liberalized financial markets. With a much more dispersed and varied investor base than in CMEs, publicly available financial information becomes the basis upon which to make decisions. Even short-term changes in valuation in the equity markets can lead investors to place their money elsewhere, making the whole system that much more dependent on the lack of restrictions. Mergers and acquisitions, including hostile takeovers, are tolerated as adequate responses to decline in profitability or expected reduction in market value.

With deregulated labor markets, companies can easily adjust their human resources to changing market conditions, allowing them to tap into the movement of scientists and engineers. Allied with the licensing and trade of technology (especially in sectors where effective patenting is possible), this capacity to easily hire talents guarantees technology and knowledge transfer within the economy.

Figure 2 – Institutional Complementarities in the American Economy



Source: Hall and Soskice, 2001

Expanding the Basic Dichotomy

Critics of the original Hall-Soskice paradigm pointed to a variety of weaknesses in the analysis of modern capitalist organizations. The absence of the state and the prevalence of economies that do not conform to the ideal CME and LME types were particularly important and were addressed in *Beyond Varieties of Capitalism: Conflict, Contradictions and Complementarities* (2007), edited by Bob Hancké, Martin Rhodes and Mark Thatcher.

While the authors accept the validity of some of the criticism, they steadfastly hold to the basic tenants of the original paradigm, arguing that Mixed Market Economies (MMEs), such as Italy or Spain, do not present a conclusive exception to the basic model. Much to the contrary, they argue that these types of economies would eventually change towards one or another of the ideal models were it not for the strong participatory role of the state which maintains the *status quo*. Caught between two worlds, these economies will, *ceteris paribus*, underperform those found in either extreme (Hancké, Rhodes and Thatcher, 2007).

Adoption of one or another model would be the key to overcoming these deficiencies, but such convergence does not come easily. In the case of Italy and Spain, for instance, the state is still prey to interest groups that impede either a more coordinated approach to coordination problems or more free-reign to markets. This form of hybridization is still sufficiently pervasive to qualify both as MMEs (Moline and Rhodes, 2007).

Stretching the VoC Approach

The division between two pure types of capitalist economies is one of the defining traits of the VoC approach. Countries cannot maintain a position of ambivalence between the two extremes and eventually adopt one or another model, except in those cases where the state is strong enough to mediate the conflicting demands existing in that position. Yet, many scholars feel dividing the world into only a few specific categories does not do justice to the vast complexities found in our modern world and fails to capture the many changes that it is undergoing.

Despite its weaknesses, the approach presented researchers with an interesting framework that could be applied to a variety of countries which had not previously been subject to it. Schneider (2009), for instance, used it to analyze the specific variety of capitalism in Latin America, noting how well it complemented recent research by identifying those structural elements still unchanged in the region despite wide reaching economic and political reforms.

The author identifies non-market power-based relations, especially by local business groups and multinational corporations (MNCs), as being fundamental in

the organization of capital, labor and technology in the region, hence qualifying these economies as Hierarchical Market Economies (HME). HMEs are characterized by four fundamental pillars: 1) large diversified business groups (usually family-owned and controlled) responding for a large proportion of economic activity; 2) multinational corporations, which have been predominantly dominant in manufacture, but are now expanding into finance, utilities and other services; 3) atomistic labor relations where employees have very short job tenure, the informal market is considerably important, and unions are much more politicized with little or no impact in employer-employee negotiations; and 4) low skilled labor resulting from historically low investment in education, limited private investment in R&D and low employee training by local business groups given the constant threat of "poaching" by MNCs.

Like the traditional VoC approach, Schneider (2009) argues that the different institutional arrangements are mutually reinforcing, making deep structural changes all that more difficult. Nonetheless, contrary to what is found in other economies, "this resilience is less the result of internal equilibrium and more a matter of resistance to exogenous pressures for change" (Schneider, 2009, 569). The future[2] will tell whether this situation will remain as the region becomes progressively more integrated and influent in the world stage.

In another article, Schneider (2008), the researcher presents some elements of capitalist organization where trust and reciprocity are the essential elements in the allocation of resources. In these Network Market Economies (NMEs), informal networks permeate the economy and are based on long term, non-contractual and face-to-face interactions. For instance, the *keiretsu*, Japanese network-based business groups, are multisectoral and provide strong linkages between sectors, allowing for long-term relationships to develop and coordination to be mediated. Workers invest in specific skills in the knowledge that they will be rewarded with lifetime employment or enjoy the benefits of participating in these informal networks. As a result, NMEs excel at manufacturing and incremental innovation.

[2] Schneider (2008) states that the HME typology can be used for most developing countries. Bresser-Pereira (2012) follows similar lines of reasoning, but opts rather to categorize developing countries as either liberal-dependent (following the recommendations of the Washington consensus) or developmental (having a clear government-driven economic development agenda).

A final example comes from Nölke and Vliegenthart (2009). They apply the framework to countries in East Central Europe, characterizing them as Dependent Market Economies (DMEs), because of the importance of Foreign Direct Investment (FDI) to their growth. The "dependence" comes from the fact that these investment decisions are made by MNCs with headquarters abroad, national governments having limited control over them. Alongside the importance of FDI, DMEs are further portrayed through: 1) a corporate governance model where negotiations between subsidiaries and headquarters take center stage and organize the remaining business structure; 2) employee-employer relations that are negotiated at a firm level with moderate government participation; and 3) an educational system focused on vocational skills adapted to the dominant industry sectors (assembly platforms of semistandardized goods).

Table 1 below summarizes the main types of capitalist organizations, based on the Hall-Soskice original approach.

Table 2 –Types of capitalist economies according to the VoC approach

	Core Theory		Extended Core	Expanded Framework		
	Liberal Market Economies	**Coordinated Market Economies**	**Mixed Market Economies**	**Hierarchical Market Economies**	**Network Market Economies**	**Dependent Market Economies**
Allocative principal	Markets	Negotiation	State mediation	Hierarchy	Trust	MNCs hierarchies
Stock ownership	Dispersed	Blockholding	Blockholding	Family block-holdings	Blockholding and cross-ownership	Headquarters of MNCs
Predominant type of large firm	Specialized managerial corporations, MNCs	Bank controlled firms, business groups	State-run or state-protected	Hierarchical business groups	Informal business groups	Subsidiaries of MNCs

Employment relations	Short term market	Long term, negotiated	Long term, state mediated	Short term, market	Life time employment	Medium term
Skills	General	Sector specific	Low	Low	Firm specific	Limited (vocational)
Comparative institutional advantages	Radical innovation, services	Incremental innovation, manufacturing	Dual: specialized industries and low price firms	Commodities, global production networks	Incremental innovation, manufacturing	Assembly platforms for industrial goods
Representative case	United States	Germany	Italy	Chile	Japan	Poland

Source: based on Amable (2003), Desatnik (2011), Molina and Rhodes (2007), Nölke and Vliegenthart (2009), Schneider (2008) and Schneider (2009)

Testing the VoC Approach

While some researchers have opted to expand the different categories of capitalist economies to better take into accounts elements which have been overlooked by the original proponents of the theory, others prefer a more statistical approach and seek to refute, defend or qualify some of the results of the VoC approach. The complexities of this path are brought to light in Schneider and Paunescu (2012). Capturing the essence of the framework involves a two-step procedure, a method seldom carried out in most empirical research: 1) testing the CME-LME typology; and 2) testing the link between the types of capitalist organizations and industry-specific comparative advantages. These difficulties are further compounded by the choice of which institutional arrangements to use, all too often limited to the labor and financial markets. The education/training system and inter-firms relations are usually ignored, weakening the ensuing conclusions.

Unsurprisingly perhaps, the authors state that only Schneider, Schulze-Bentrop and Paunescu (2010) have sought to capture all the complexities of the approach in a comprehensive testing procedure. Their results provide mixed support for the VoC approach, seeing evidence that LMEs generally hold competitive advantage in high-tech industries. Nonetheless, some hybrid models such as Belgium or

Finland, which combine elements from both economy types, also exhibit strong high-tech performance.

Schneider and Paunescu (2012) take one step further in this analysis, building upon the same framework, but including a wider range of countries, years of studies and indicators. Their study consists in statistically "clumping together" different economies at different points in time, comparing them then to what the theory originally predicts. As before, they conclude that the types of capitalist economies are much more varied than what is expected, identifying four different types: LMEs (and LME-like[3] economies), CMEs (and CME-like economies), state-dominated (similar to the Mixed Market economies discussed above) and hybrid economies (which the authors dismiss given the heterogeneity of the countries found within this typology).

Furthermore, they conclude that institutional change is much more intense than predicted by the original theory, with many countries veering towards a completely different institutional arrangement in the space of only a few years. Although the bulk of these represent a move towards more flexible LME type economies, there are examples of the opposite movement, such as Belgium and Italy moving towards CME types of arrangement. This is particularly interesting to note since, given the evidence that sector-specific advantages and disadvantages hold between different types of organizational model, countries that do change their institutional arrangements must adapt their industry structure accordingly. An industry in a country moving towards LME arrangements will fare better should it adopt more radical forms of innovation and strengthen their high-tech elements. The opposite holds true for those countries doing the opposite change.

While statistical tests constitute a powerful way to confirm or disprove theories, case studies can also contribute to this goal. Campbell and Pedersen (2007), for instance, use the successful case of Denmark to illustrate how one of the basics tenants of the VoC approach, namely institutional complementarity, might not

[3] Both CME-like and LME-like economies portray many characteristics of their pure-type counterparts, but are not fully coherent in all indicators.

hold in the real world. The authors argue that a blending of opposing institutional characteristics, contrary to the stated theory, does not necessarily lead to weaker economic performance. This is so because institutional deficiencies found in either CMEs or LMEs can be countered by adopting elements of the opposite type of institutional organization.

They use Denmark to prove their point stating that LME-type elements were introduced in the labor markets (local and firm-level negotiation, flexibility), in vocational training (decentralization, competition among technical schools, training for the unemployed) and in industrial policy (neoliberalism). These changes did not undermine the fundamental CME-like quality of the Danish economy and, yet, the country enjoyed sustained economic performance. If mixed economies can fare better in the world stage, then the core concept of institutional complementary might be completely wrong.

Limitations to Testing the VoC

Despite the differing attempts to either prove or disprove the VoC approach, testing the theory is far from straight forward. Both statistical tests and case study analysis have inherent limitations that are only reinforced when we note the inherent ability of institutional arrangements to adapt to internal and external threats and opportunities.

Desatnik (2011) shows, for instance, that clusters are more frequent, larger and diverse in LMEs. The author posits that, in their search to gain the advantages of CME-like economies, especially long-term relationships based on cooperation and mutual understanding, LMEs look to clusters for a solution. That they were successful can be seen by the importance the issue has gained in modern economic policies.

These adaptations by existing institutional arrangements are not directly interpretable when looking at data. One might see changes towards another institutional form, when all there is to see is merely adaptation resulting from internal or external shocks. Even case studies cannot easily solve this. For instance, going back to the Danish case (Campbell and Pedersen, 2007), its

adoption of LME type characteristics can also be interpreted as the CME's equivalent to strengthening economic clusters, rather than a move towards an MME (or LME)-like economy.

3. Innovation in the Varieties of Capitalism

3.1 Innovation as a Reflection of the Dichotomy

The complexity of innovation practices did not deter researchers from trying to quantify, characterize or classify it and this holds true within the Varieties of Capitalism approach. The original dichotomy between CMEs and LMEs translated into two different forms of innovative activities. While the former are more adept at incremental innovation as exemplified by the German Diversified Quality Production system, the latter excel at radical innovation such as those seen in the technologically dynamic Silicon Valley.

Radical Innovation in Liberal Market Economies

In LMEs, it is argued that companies focus on radical innovation which "entails significant changes in product lines, the development of entirely new goods, or major changes to the production process" (Hall and Soskice, 2001, 38-39). It further highlights that this is a characteristic of fast-moving technology sectors such as biotechnology, semiconductors, software development, telecommunications, defense, airlines, advertising, corporate finance and entertainment.

The technologically dynamic Silicon Valley is an example of such a system. The whole region is marked by networks of inter-dependent, yet autonomous firms which have developed thanks to the surge of computing technology, but with very little outside help (Saxenian, 1991). The deep relationships between strong supplier-consumer networks are further reinforced by the cross-fertilization effects of large turn-over rates. Whether it results from a disenchantment of company strategy, a wish to confront new challenges or a search of an outlet for their latest invention, employees seek new companies on a regular basis or form entire new firms, spreading technology throughout the industry, in a fashion

similar to what has been observed in the beginnings of the auto-industry (Klepper, 2007).

Incremental Innovation in Coordinated Market Economies

For CMEs, the VoC framework argues that firms' innovation approaches are focused on incremental innovation, the gradual and continual improvement in product lines and processes. With the hypothesis that certain types of innovation strategies are more important than others, it defends that CMEs are particularly adept at maintaining competiveness in the capital goods sectors such as machine tools, factory equipment, consumer durables, engines and specialized transport equipment. The German Diversified Quality Production system is an example of such an approach which combines high production output with customization in both the development and production of goods and services. With inherent difficulties found by management to coordinate complex tasks (given low levels of top management power, strong occupational identity and consensus-based processes), decisions are made at the local level (Williams, Geppert and Matten, 2003). While this guarantees constant improvement of processes and step-by-step advances in technological levels, strong changes to existing product lines are discouraged because of its disruptive effects on the employed workforce.

The Sources of Difference between CME and LME Innovation

Innovation practices vary according to the type of capitalist economy because of differing characteristics of 5 different elements.

Skill formation and labor force qualifications

LMEs favor general skill training that is highly transferable from company to company. This, combined with industry specific knowledge acquired in different jobs, provides the mean for employees to carry out radical innovation. CMEs tend to provide to employees firm or industry specific skill training which are non-transferable or transferable to a limited degree. Employees will tend to have a profound knowledge of processes which will allow them to carry out incremental innovation (Estevez-Abe, Iversen and Soskice, 2001). Micro-data analysis in the pharmaceutical industry of the UK, Germany and Italy seem to confirm that

companies that carry out radical innovation require a labor force with more general-specific skills, while those that opt for an incremental innovation strategy require a labor force with more specific skills (Herrmann and Peine, 2011). This is further reinforced when the synergies between skill formation and the type of scientific knowledge are made apparent. Radical innovation requires a labor force with general skills and hired scientists with a heterogeneous background. The opposite is true (specific skill sets and homogeneous background) for those companies pursuing a more incremental approach.

Legal framework

LMEs favor classical contract law where the focus is on enforcing written contracts, irrespective of perceived negotiation imbalances or the favoring of one party over another because of unanticipated events not covered previously. CMEs, on the other hand, favor the regulatory approach which focuses on power imbalances between parties in an attempt to apply societal norms to the just fulfillment of contracts. It does so, for instance, by avoiding that stronger market actors delegate risks to weaker ones rising out of incomplete contractual provisions. Like the above, the LMEs' legal framework creates the flexibility necessary for radical innovation, while the CMEs' approach reinforces the stability, consensus and mutual interdependence necessary for incremental innovation (Casper, 2001).

Ownership structure and top management power

In LMEs, where markets play a more significant role, the weak formalized role of constituencies other than shareholders allow top management to make drastic changes in business strategy, operations, investment, employee policy and others in order to maintain high returns. The opposite is true for CMEs, where "non-market" institutions are more important vis-à-vis the other organizational model. Different constituencies enjoy a strong formal voice and will hinder attempts at making drastic changes which can undermine their position or objectives. As a result, while the former allows for radical gambles in new technologies, products or services through top-management leadership, the latter stresses the importance of dialogue and consensus within one firm and the deepening know-how which can improve processes, procedures and benefits of existing products and services (Vitols, 2001).

Diffusion of knowledge

In LMEs, technology and knowledge is transferred throughout the economy by a constant rotation of skilled employees from one company to another (Hall and Soskice, 2001). As these processes have larger transaction costs, LMEs have answered with the development of clusters, "or agglomerations of closely related industries, in new business formation (…). The presence of a cluster of related industries in a location will foster entrepreneurship by lowering the cost of starting a business, enhancing opportunities for innovations and enabling better access to a more diverse range of inputs and complementary products" (Delgado, Porter and Stern, 2010, 495-496). Clusters being the answer to these specific coordination problems, it is expected that they be more fully developed in LMEs than in CMEs (Desatnik, 2011).

Furthermore, given their specific legal regime where the content of written contracts takes precedence over the "principles" behind contracting, clear terms of cooperation are a need in LMEs. As a result, it is expected that joint ventures and strategic alliances be much more common in LMEs than CMEs. An element of this can be found in the considerable increase in technology sale, made possible with a strong patent system. With the break-up of the "Chandlerian" firm, which perceived technology breakthroughs as a closely-guarded secret to be used solely within the company structure (Chesbrough, 2003) and the resurgence of globalization, which opened trading opportunities between a variety of economic actors (Frieden, 2006), the 1990s saw an unprecedented rise in technology sale, reminiscent of the dynamism of the late 19th century (Arora, Ceccagnoli and Cohen, 2007). With notable exceptions, this rise in technology sale has been driven by companies within LMEs.

The opposite holds true for CMEs. Diffusion of knowledge and technology is done through sectoral cooperation involving all companies operating in a given industry (Hall and Soskice, 2001). Informal cooperation is much more common thanks to organizations, such as collaborative technology transfer institutes, and not commonly found in statistical data. Large companies are embedded within networks of powerful trade and industry associations, as well as para-public institutions where labor and interest organization also participate. Add to this a

well-developed apprenticeship system and co-determination laws that empower unions and other stakeholders and we find a system that relies on a level playing field of bargaining which sets the stage for the terms of industrial/technical change. The end result is a form of "lock-in" where managers and employees must develop long-term relationships, aiding the formation of competence-enhancing human resource strategies and fostering the need for organizationally complex collaborative firms where inter and intra-firm exchanges are common place and departmental boundaries more fluid. Contrary to LMEs, knowledge flows easily through these forms of public/private or private/private collaborative instances (Casper and Whitley, 2004).

Financial system

Professional venture capital companies are considered the tool-of-choice for funding radically new products or services. This is because the high risks involved in this particular type of investment must be compensated by large returns. Nonetheless, despite their reputation for funding innovation, they still represent a very small fraction of total investment in an economy. In Europe, for instance, only 2% of small- and medium-sized companies used venture capital (Commission of the European Communities, 2009).

In the VoC approach, it is expected that venture capital be prevalent in LMEs where radical innovation is the norm. CMEs would have less developed venture capital markets given the dominance of bank lending and the importance of incremental innovation (Hall and Soskice, 2001).

3.2 A Complex Reality: Limits to the Analysis

Statistical Challenges

Despite arguments in favor of it, separating innovation between two spheres has understandably brought it severe criticism. Kang (2006) and Werle (2012) point to its simplistic and coarse nature. Crouch (2005) argues that the original Hall and Soskice statistical test used to show the radical VS incremental divide is faulty in that patent citation can be more readily explained by the legal regime, whereby

patenting is much more common in countries of common law as a form of business strategy.

Taylor (2005) highlights that the data only holds true when a major outlier, the United States, the most important contributor to radical innovative output, is included in the set of radically innovative countries. Furthermore, expanding the date used to cover the 1963-1999 period (Hall and Soskice, 2001, considered only the 1983-1984 and 1993-1994 period) adds considerable uncertainty to the explaining power of the theory, suggesting that the differences in the types of innovation carried out by LMEs and CMEs is not as clear-cut as the theory proposes. Finally, the basic distinction between radical and incremental innovation does not hold true through time. Industries tend to start out radically innovative as new inventions significantly influence further development and different designs compete for dominance. Nonetheless, as they grow and mature, they adopt patterns of incremental innovation.

Akkermans, Castaldi and Los (2007), for their part, use patent citation data to test whether LMEs innovate more radically than CMEs. While the result holds for only one of their testable variables – the ORIGINAL indicator, used to capture the broadness of knowledge contained within a patent (a sign of radicality) –, this is not the case for the other variables. Moreover, differences are much more pronounced when considering sectoral differences with LMEs specialized in radical innovation in chemical and electronics industries and CMEs specialized in radical innovation in metals, machinery and transport equipment industries.

Another critique comes from Herrmann and Peine (2011). The authors highlight that, despite results that show radical innovation requiring general skills and incremental innovation requiring specific skills, country differences are not supported. There are no significant differences in the amount of companies undertaking radical and incremental innovation between coordinated market economies (e.g. Germany) and liberal market economies (e.g. UK). Radically and incrementally innovative companies are found in both.

Conceptual Challenges

Even within the VoC approach, what is included under the headings of radical and incremental innovation is sometimes so broad that it empties the concepts of much theoretical depth. While mostly used to support sectoral differences in competitive advantage, the innovation dichotomy can also be applied to differences in business strategy within a single sector. Lehrer (2001), for instance, does exactly that for the civil aviation industry prior and during the deregulation of the mid-1980s. Lufthansa, embedded in its CME environment, was able to provide more comfort, reliability, and punctuality than any other of its competitors because these were areas where incremental innovation was key.

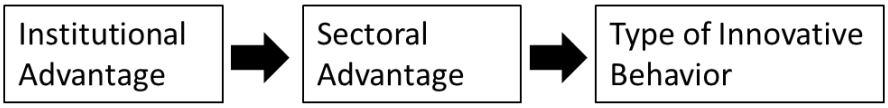
During the deregulation period, the many changes to the industry made selling, distribution channels and marketing fundamental competitive differentials. In an environment where radical innovation in the form of completely new strategies was required, British Airways became the leading market player. The LME economy from where it operated supported the unilateral top-down changes required to restructure the company in such a way as to gain advantage in those turbulent times. Nonetheless, as the market stabilized once more, this advantage deteriorated and by the end of the 1990s, both Lufthansa and Air France managed to catch up with and improve on the practices adopted by their competitor.

A second source of conceptual difficulties lies in the causal connection between the type of capitalist organization and the type of innovation. Whether used to highlight sectoral competitive advantage or business strategy, the difference between radical and incremental innovation is a direct reflection of the dichotomy between CMEs and LMEs. Countries in CMEs are better able to innovate in sectors such as machine tools and factory equipment, consumer durables, engines and specialized transport equipment. On the opposite end, LMEs are better able to innovate in industries, such as biotechnology, semiconductors, software development, telecommunications and defense systems (Hall and Soskice, 2001).

The implicit assumption is that the sectors are characterized by certain types of innovative behavior. Biotechnology, for example, relies on radical innovation whereas specialized transport equipment depends on incremental improvements. As a result, innovation is a dependent variable in the model, the result of a

countries sectoral specialization. It is not a force unto itself, as we see in the illustration below.

Figure 3 – Causality in the VoC model in regards to innovation



This is particularly problematic because it implies that LME countries are at the forefront of technological discovery, given their particular advantages in future-oriented industries such as information technology. CMEs are doomed to excel solely in declining and traditional industries, completely ignoring the radicalness of innovation carried out by Germany in its past in steel, chemicals or motor vehicles (Crouch, 2005).

A third conceptual difficulty rests in how firms manage to influence their surroundings, and not only be influenced by them. Firms are conditioned by their environments to adopt one particular stance or another, resulting in homogeneous strategies across countries with similar institutional frameworks. Despite the focus on the individual company, the VoC framework offers little on how firms ignore institutions, reinterpret them or rearrange them altogether, a point of particular importance given globalization and the rising importance of multinational companies (Jackson and Deeg, 2008). Such inclusion of a two-way influence where institutions influence company strategy and vice-versa (a slowly emerging view according to the authors) imply to a certain extent that institutional linkages are much more fluid than originally thought and open up the field for the exploration of a plethora of different strategic choices, including our particular concern: innovation.

Passing from Micro-Realities to Macro-Realities

The tension resulting from the passage between micro and macro realities are evident in the case of the dichotomy between radical and incremental innovation. These concepts were originally used on a micro scale to define how companies would compete. Introducing an entire new product or tweaking an existent one, despite all the difficulties attached to this simplification, was a strategic choice to

gain market share, improve the bottom line or any other business objective. Passing to a macro reality hides the complexities inherent in passing from one dimension to another – much is lost in the ensuing analysis and this practice is warned against by researchers (see, for instance, Moldaschl, 2010). Micro and macro realities differ and these differences cannot be captured solely by the sum of individual actions. Each level of human society has its own timeframe and its own logic which is both influenced and influences subsequent levels (see, for instance, Brand, 1999).

This tension between micro and macro realities are compounded by the difficulties in properly classifying innovation within any of the two categories. Oftentimes, it lies very much in the eye of the beholder. An interesting illustration comes from de Brentani (2001) where 43% of managers of business-to-business service projects classified their offerings as radical innovation, despite the scholarly conclusion that this type of practice should be much rarer in the market place.

Response of VoC Researchers

It is interesting to note that contentions regarding the weakness in addressing the issue have barely been addressed in the update of the original Hall-Soskice framework *Beyond Varieties of Capitalism: Conflict, Contradictions and Complementarities* (2007). It does not figure in the list of the main criticisms of the theory (Hancké, Rhodes and Thatcher, 2007) and the only mention to innovation is found in chapter 6 where the institutional variations of Switzerland and Germany are analyzed and the basic dichotomy reinforced (Börsch, 2007). And, even there, the concept of incremental innovation is hardly more detailed than in the original framework, the author preferring to identify it as the result of diversified quality production.

Nonetheless, researchers have not been completely absent in the innovation debate. An important contention inherent in the distinction between CMEs and LMEs' respective innovation practice is that CMEs would, in the long run, have a lower economic performance than in LMEs. If the latter is responsible for technological breakthroughs, the larger returns would fuel a more dynamic

economy and be constantly on the technological edge. This is countered by VoC researchers by highlighting the qualitative nature of innovation practices between the different types of economies.

Let us consider the distinction between discrete and cumulative technologies (Casper, Lehrer and Soskice, 1999). The first have a highly focused range of application, mass market potential and a short time window of opportunity, whereas the second has longer time horizons and broader application. Specific therapeutic drugs and software products are examples of the former, while platform technologies (upon which other technologies can be developed) and software services are examples of the latter. Germany, given its specific institutional make-up, is very proficient in the latter. In other words, even a typical CME can have vibrant high-tech sector, the difference based upon the nature of the technological offerings.

Casper and Soskice (2004) and Casper and Whitley (2004) follow a similar line of reasoning and use the main theoretical frameworks to explain differences in high-tech sectors in the UK, Germany and Sweden. Unsurprisingly, they argue that Germany's competitive advantage in biotechnology and software development lie in the fact that companies within its national boundaries specialize in platform technologies (biotechnology) and enterprise software (software development), sectors where incremental innovation is key. Companies that need radically new products, such as in the therapeutics sector or packaged software in the software development sector, are few and far between.

Nonetheless, they do highlight some of the limitations of their country analysis. Sweden, a typical CME economy, has managed to develop a vibrant community of radically innovative firms thanks to the multinational company Ericsson. The company supported industry-specific standards such as the "open-source" development language Erlang and wireless connectivity standards such as Bluetooth and WAP. Furthermore, it facilitated employees' wish at trying their hand at technology entrepreneurism. Through these actions, it managed to create a mini-LME environment within an economy characterized by CME-like relationships. The result was the creation of a variety of radically innovative software firms.

While Sweden illustrates success, the UK illustrates the opposite. While it was successful in competing head-to-head with the US in biotechnology in the 1990s, by the end of the decade, it encountered significant challenges. Insufficient venture financing, unsophisticated investors and a general lack of specialized labor made competition increasingly more difficult with the US, a country which did not suffer any of these limitations. Despite an environment that would allow the UK to compete effectively, a significant lack of resources resulted in more than lackluster performance by the British Isles.

Casper (2009) adds to this overall argument the concept of efficiency – radically innovative companies are much more successful in liberal markets economies, while incrementally innovative companies excel in coordinated market economies. Those few examples of radically innovative companies coming from Germany have overcome the weaknesses found in their environment by tapping into the resources and particular advantages of liberal market economies.

To illustrate, it is important to mention that, despite governmental efforts to foster the biotechnology industry in Germany, some 270-300 firms of the 346 total firms in the sector are starved of capital or facing unfavourable prospects. Some of the roots of this problem can be traced back to the preference of the German financial system towards credit and bank finance. The venture capital industry remains a struggling sector, with 80% of companies having closed shop since 2001, and has not grown deep roots in the country. Although biotechnology firms exist in the country, the prospects of survival are much slimmer than in countries that adapt more liberal institutional arrangements.

In conclusion, despite attempts at enriching the analysis of innovation practices, the dual-category of radical and incremental innovation is still very much in use. Attempting to go beyond this dichotomization can yield potentially better understanding of how innovation can vary within different institutional settings.

4. Statistical Test of Innovation Practices

4.1 A Short History of Innovation Indicators

Even since innovation became an object of study, researchers have tried to understand how to capture its essence through quantitative means. Although not the first, one of the most cited precursors to quantitative innovation studies is the economist Robert M. Solow. In his seminal work *Technical Change and the Aggregate Production Function* (Solow, 1957), the 16th most cited article in innovation studies (Martin, 2012), the author showed that gross output per man doubled in the United States between 1909 and 1949. The vast majority of this growth (87,5%) was due to technical change, with the remainder explained by increase in capital. The "Solow residual", as it came to known, captured upward shifts in the production function and exemplified the importance of technological development to economic performance.

With the increased attention paid to technological development, not least of which due to the adaptation of military technology to consumer use, Research & Development (R&D) became the leading indicator to measure innovation efforts within a countries. To a large extent, this reflected the rise of the Chandlerian firm with its in-house R&D department, as well as the professionalization of the research profession for commercial purposes (Freeman and Soete, 2009). The *Frascati Manual*, which appeared originally in 1963, defined R&D as "comprising both the production of new knowledge and new practical applications of knowledge […] covering three different types of activities: basic research, applied research, and experimental development" (Smith, 2005, 153).

While considered the innovation indicator *par excellence,* our increased understanding of innovation and the changing economic landscape begged for a more diverse set of indicators (Freeman and Soete, 2009). In 1992, the OECD attempted to synthetize the latest advances in innovation research and proposed a best-practices guide known as the *Oslo Manual*. The *Community Innovation Survey,* carried out by the European Commission, adopted many of its recommendation, generating five classes of indicators: 1) expenditures on innovation (both R&D and non-R&D); 2) outputs and sales of incrementally and radically changed products; 3) sources of information relevant to innovation; 4)

technological collaboration; and 5) perceptions of obstacles to innovation, and factors promoting innovation. Although micro-focused, the methodology allowed for international comparisons between countries and showed many interesting facets of innovation processes, including the conclusion that innovation is pervasive throughout modern economies and that non-R&D inputs to innovation are particularly important in non-high-tech sectors (Smith, 2005).

Today, many countries are being compared on the basis of a composite innovation indicator. This gives rise to three important problems: 1) the choice of indicators; 2) the pre-treatment to apply (what kind of normalization to use); and 3) the way the indicators will be merged. While the first is the domain of theory, policy and practice, the last two are statistical in nature (Grupp and Schubert, 2010). For this reason, choosing a good mathematical framework is important in order to avoid communicating false information. The authors show, using data from European Innovation Scoreboard 2005, that different weighing methods (unweighted average, benefit of doubt methods, DEA-related methods, etc.) are not robust and, therefore, change according to the procedure used. They recommend using a shadow-price technique, frequently used in economic studies.

Nonetheless, this debate is far from over. Cerulli and Filippetti (2012), contrary to Grupp and Schubert (2010) and using data from 138 countries, state that the arithmetic mean is not biased in practice, though it might be in principle. They posit that countries achieve differing degrees of complementarity in technological capability according to level of income. This complementarity guarantees that indicators will be correlated, thereby eliminating bias in calculations. It wouldn't be wrong to conclude that "Research on [Science, Technology and Innovation] indicators appears today as challenging as ever" (Freeman and Soete, 2009, 588).

4.2 Limitations of Current Statistical Analysis

The search for a quantitative understanding of our world has many merits, but also many drawbacks. Enamored by the success of economics, especially econometrics, in translating the world into easily understandable macro statistics, innovation researchers have embarked on a similar endeavor. Yet, social statistics are prone to errors due mainly to difficulties in measurement. GDP, for instance,

does not fully capture the output of sectors such as health, education, government or the environment, nor does it lend itself easily to international comparisons, even when using purchasing power parity adjustments (Freeman and Soete, 2009). The same applies to innovation indicators.

Since innovation is not a directly observable phenomenon, but rather, the result of countless interactions between actors, measuring it becomes incredibly complex. As a result, whatever we measure on a macro-scale is a mere proxy of innovation, an attempt at capturing a multi-faceted and multi-step process through a narrow window. For example, Kleinknecht, Van Montfort and Brouwer (2002) showed, through factor analysis, that the five innovation indicators under study (R&D man-years, number of European patent applications, total expenditure on innovation, sales of products "new to the firm", and sales of products "new to the market") show little correlation between themselves. In other words, all five indicators are non-interchangeable and, therefore, captured different aspects of the innovation process.

Furthermore, innovation statistics are vulnerable to the so-called Goodhart law – that is, observable statistical regularity will collapse, once it becomes the subject of explicit policy (Chrystal and Mizen, 2001). The reason behind this is that policy makers will attempt to target the causal variable in the cheapest and fastest way possible, thereby distorting the relationship which had been uncovered (Freeman and Soete, 2009). For example, let us suppose that university research quality is positively correlated with innovative practices within an economy. In order to improve the country's innovative capacity, policy makers will attempt to foster quality in university research. Yet, translating this into practice is not entirely straightforward. They may, for instance, invest resources "across-the-board", including on activities which do not lend itself well to innovation processes because of a lack of adequate actors, such as companies which can absorb this research. This law makes understanding correlations, causes and essential factors within innovation processes all that more difficult.

To conclude, irrespective of the advances made, we must always be wary that the social sciences can never hope to reproduce what the physical sciences manage: a fully mathematical representation of the world around us. This is not to say that

innovation indicators are useless. Much to the contrary, like the common aggregate innovation indicators we use today, they are an important conveyor of messages regarding the importance of innovation for our societies, where the challenges lie and where to go in the future (see Grupp and Schubert, 2010). Nonetheless, they must be taken with a grain of salt and constantly improved and challenged. "Keeping an open and critical mind particularly with respect to the most commonly used indicators with the aim of continuous improvements of [Science, Technology and Innovation] measurements is therefore an absolute must" (Freeman and Soete, 2009, 585).

4.3 Data

It is within these restrictions that we must consider both the available data and the analysis to be carried out in this and the next section. The reader will recall that there are 5 main sources of difference in innovation practices between economies within the VoC framework: 1) skill formation and labor force qualification; 2) legal framework; 3) ownership structure and top management power; 4) diffusion of knowledge and knowledge sharing; and 5) the financial system (see 3.1).

Skill formation and labor force qualification seek to capture the extent to which vocational and university training is available in the economy. As such, two different variables are considered: university training (percentage of total population attending university) and vocational training (percentage of total population attending vocational training).

The legal framework considers 2 elements. The first is the legal regime in force in the country. It is composed of 3 possibilities: common law (based on legal precedent, where court judges are bound in their decisions by earlier rulings), civil law (based primarily on legislation and secondarily on custom) and mixed systems (a category where civil and common law coexist with each other and/or with another system, such as religious law). The second element is legal uncertainty that shows the extent to which business can expect an efficient settling of any commercial dispute.

Ownership structure and top management power captures how much unilateral power top management has in determining and enforcing strategic decisions. The variable is far from being perfect and the proxy used is delegation, which translates into willingness to delegate authority to subordinates.

Diffusion of knowledge and knowledge sharing is an important aspect to innovation work and, as a result, should attempt to capture various facets. It includes technology absorption (extent to which businesses absorb new technologies), clusters formation (prevalence of well-developed clusters), university-industry collaboration (collaboration on R&D between businesses and universities), and joint venture and strategic alliance (number of joint venture and strategic alliance deals).

The financial system considers the extent to which venture capital deals are present in the economy. We expect that this variable captures differences in the preferred modes of financing between economies. LMEs, for instance, rely heavily on venture capital to finance new breakthrough technologies. CMEs, on the contrary, prefer banking to finance new technologies. Therefore, for the latter, the amount of venture deals should be considerably lower.

In order to "anchor" the analysis to a real-world sector, the cleantech sector (see box 1), we have used the information and considerations found in Cleantech Group and WWF (2012). Therefore, to the variables above, we have added 4 additional ones relating to countries' performance in the clean technology sector: 1) general innovation drivers (general conditions that facilitate the development of innovative start-ups); 2) cleantech specific innovation drivers (drivers that promote cleantech technology invention, commercial adoption, company growth and government policies); 3) evidence of emerging cleantech innovation (emergence and early-stage progress of cleantech innovation and entrepreneurial cleantech companies); and 4) evidence of commercialized cleantech innovation (ability of a country to scale up innovations developed by cleantech start-up). This addition represents an attempt to better anchor the discussion in reality and, while this choice has been arbitrary, the sector is an interesting one to analyze given its importance to human development (Newell, Phillips and Mulvaney, 2011) and the potential widespread destruction of runaway global warming (Stern, 2006).

Box 1 – Clean Technology Sector

Cleantech, also known as greentech, sustainable technologies or environmental technologies, are a subgroup of technologies that deliver positive financial returns and produce positive environmental impacts or outcomes. While the range of technologies in this sector is quite large, spanning agriculture, waste, materials, among others, the vast majority is made up of energy related products and services. Venture capital is a common yardstick to gauge the importance of clean energy in the cleantech sector. In 2010, for instance, 77% of venture capital was invested in energy-related technology (Cleantech Group and WWF, 2012).

Cleantech is a sector of incredible dynamism with some technologies, such as solar photovoltaic, wind or biofuel, seeing growth rates in the two-digit figures. The Blue Map 2020, a target-oriented scenario proposed by the International Energy Agency (IEA) with aims of halving energy-related CO_2 emissions by 2050 (in relation to 2005), is a good gauge of how far clean energy has penetrated modern economies. While solar photovoltaic and wind power are making large strides towards contributing to a cleaner world, other technologies, such as concentrated solar power, carbon capture and storage (process by which waste CO_2 is captured and stored, usually in underground geological formations) and electric vehicles, are significantly lagging behind. Today, despite advances in clean energy, the majority of our incremental energy demand is supplied through conventional means, such as oil or coal (IEA, 2011).

Box 1 – Clean Technology Sector (continued)

The choice of this particularly sector for our analysis stems from its importance in human development. Our modern economies and our modern way of life depend on large quantities of energy being supplied conveniently and at low costs (Newell, Phillips and Mulvaney, 2011). Furthermore, making the transition to a low-carbon economy is a challenge to every country, irrespective of its development path. And lastly, it is a sector where institutions and institution-building are essential because of the incredible breadth of actors participating in it (Cleantech Group and WWF, 2012) and the still necessary steps of technology development, demonstration and deployment (Narayanamurti, Anadon and Sagar, 2009).

All in all, there are 6 categories of indicators with a total of 14 indicators from 6 different sources. The discussion above is summarized in the table below.

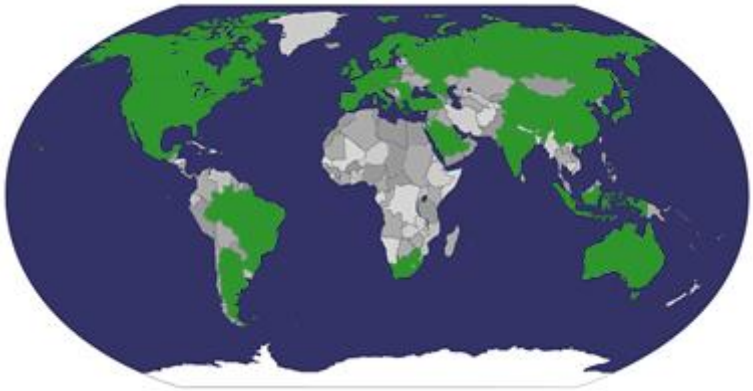
Table 3 – Definition and source of data

Main Category	Indicator	What it measures?	Source
Skill formation and labor force qualification	University training	Percentage of total population attending university	UNESCO (2012) and UN (2012)
	Vocational training	Percentage of total population attending vocational training	UNESCO (2012) and UN (2012)
Legal framework	Legal regime	Type of legal regime in force	CIA (2012)
	Legal uncertainty	How efficient is the legal framework for private businesses in settling disputes	WEF(2012)
Ownership structure and top management power	Delegation	Willingness to delegate authority to subordinates	WEF(2012)
Diffusion and sharing of knowledge	Technology Absorption	Extent to which businesses absorb new technologies	WEF(2012)
	Clusters Formation	Prevalence of well-developed clusters	WEF(2012)

	University-Industry collaboration	Collaboration on R&D between businesses and universities	WEF(2012)
	Joint venture and strategic alliance	Number of joint venture and strategic alliance deals per trillion PPP$ GDP	Cornell University, INSEAD and WIPO (2013)
Financial system	Venture capital deals	Number of venture capital deals per trillion PPP$ GDP	Cornell University, INSEAD and WIPO (2013)
Renewable Energy Indicators	General innovation drivers	General conditions that facilitate the development of innovative start-ups	Cleantech Group and WWF (2012)
	Cleantech specific innovation drivers	Drivers that promote technology invention, commercial adoption, company growth and government policies	Cleantech Group and WWF (2012)
	Evidence of emerging cleantech innovation	Emergence and early-stage progress of cleantech innovation and entrepreneurial cleantech companies	Cleantech Group and WWF (2012)
	Evidence of commercialized cleantech innovation	Ability of a country to scale up innovations developed by cleantech start-up	Cleantech Group and WWF (2012)

All these variables are studied for a total of 38 separate countries in that year where data is most recently available. The figure below shows the countries that are part of the study, while Appendix I presents the detailed list.

Figure 4 – Countries in the Statistical Analysis



Tool: World Map Maker

4.4 Statistical Test

The data has been clustered using the Two-Step clustering tool found in IBM's SPSS (Statistical Package for the Social Sciences) 21. The choice has been based on the tool's simplicity and ease of use. Furthermore, it is capable of handling both quantitative and qualitative data within a single test, a necessity given our use of the "legal regime" variable (CIA, 2012).

It is important to state that data from UNESCO (2012) and UN (2012) – university training and vocational training – are percentages. WEF (2012) – legal uncertainty, delegation, technology absorption, clusters formation and university-industry collaboration – is calculated on a scale of 1 (worse) to 7 (best). Cornell University, INSEAD and WIPO (2013) – joint venture and strategic alliances, and venture capital deals – provide scores of 0 (worse) to 100 (best). Finally, Cleantech Group and WWF (2012) – general innovation drivers, cleantech specific innovation drivers, evidence of emerging cleantech innovation, and evidence of commercialized cleantech innovation – are given in a scale from 0 (worse) to 10 (best). All quantitative data has been normalized.

Finding the best fit in a mathematical test can be a controversial topic, one which we will not address here. Suffice to say that finding automatic groupings through the SPSS algorithm has been fruitless because it divided the countries into groups of high-innovative performance and low-innovative performance. As a result, we have opted to force the algorithms to clump the countries into 5 distinct groups.

While this sacrifices how well the model fits the data, it has generated the most interesting conclusions, subject of the next section.

5. Results and Discussion

5.1 Model Results

As we can see from the graph below, with the 14 variables, the model manages a "fair" fit to the data. Forcing the software to calculate a 5-clusters option provides a more interesting conclusion to our original queries, despite the sacrifice in quality and cohesion.

It is true that an "unforced" algorithm generates a 2-clusters solution that fits the data remarkably well. Nonetheless, the sacrifice in explanatory power does not allow us to reach any relevant conclusion. As a matter of fact, it reflects the idea that innovation is closely related to economic development, with more developed countries more innovative than less developed countries.

Figure 5 – Summary of Model Results

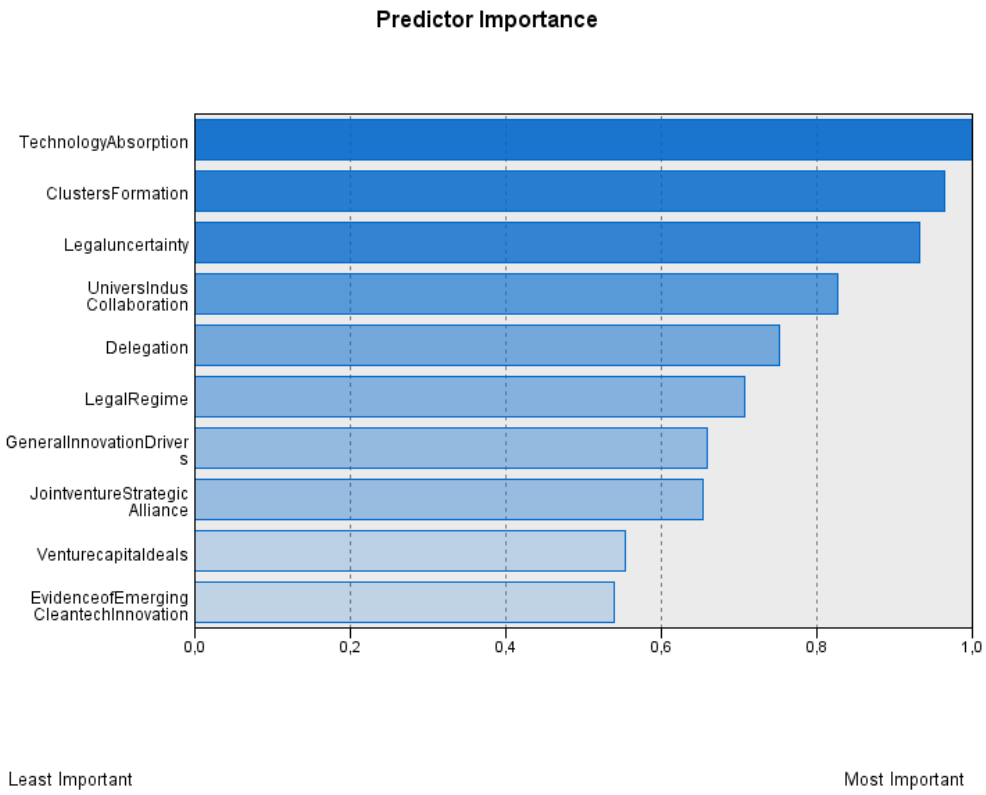
Source: SPSS 21

Figure 6 shows the more relevant explanatory variables. "Technology absorption", "clusters formation", "legal uncertainty" and "university-industry collaboration"

are the 4 more relevant, followed by "delegation", "legal regime", "general innovation drivers" and "joint venture and strategic alliances".

A small note must be made here regarding the "legal regime" variable. Despite its moderate importance in the clustering algorithm, calculations made without the variable did not manage to clump countries together as cleanly as with it. Bacher, Wenzig and Vogler (2004) state that previous versions of SPSS attributed a higher weight to differences in categorical variables than to differences in continuous variables. While they mention that IBM would correct this bias in later versions (older than 11.5), it is important to highlight that this particular variable carries considerable power in the final results.

Figure 6 – Relevance of Explanatory Variables



Source: SPSS 21

Running the TwoStep algorithm and forcing the software to divide the countries into 5 different clusters, we obtain the results found in the following table.

Table 4 – Clustering of Countries

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Austria	Brazil	Argentina	Australia	India
Belgium	China	Bulgaria	Canada	Israel
France	Czech Republic	Greece	Denmark	Norway
Germany	Indonesia	Hungary	Finland	Saudi Arabia
Japan	Italy	Poland	Ireland	South Africa
Netherlands	Mexico	Romania	Sweden	South Korea
Switzerland	Portugal	Russia	UK	
	Spain	Slovenia	USA	
	Turkey			

5.2 Interpretation of Results

Our interpretation stems from analyzing the results of the clustering process, all of which can be found in Appendix II. The first conclusion is inevitably drawn from the trends of economic growth and institution-building found in modern capitalist economies. Put in other words, countries are at differing levels of progress and this is clearly captured in the data. WEF (2012), for instance, proposes that countries are to be found in one of three stages of development: factor-driven, efficiency-driven or innovation-driven (with transition stages between them). Even when innovation is the focus of attention we find differing levels of economic development translated in the data. In Cornell University, INSEAD and WIPO (2013), for instance, Malaysia is the most innovative of non-high income countries, yet ranks only 32.

The various stages of economic development can explain much in how innovative is a country. After all, research in the most advanced of technologies requires considerable investment and resources, much of which can only be found in high-income countries. Nonetheless, it does not explain all. Countries build institutions in different ways and this development cannot be simplified by a simple linear progression from least advanced to most advanced. Raúl Prebisch, for example, already in the 1940s understood that Latin America had an institutional landscape that put it at the mercy of more advanced economies. His center-periphery model reflected the continent's economic gap and the near impossibility of bridging it through market openness. Only with a concerted effort towards industrialization

could the continent attain a level of development similar to the rich world (Prebisch, 1949). Whether the results of this industrialization were positive or not is of no importance here. Rather, we want to highlight the importance of the fact that Latin American economies organized quite distinctly in comparison to other countries in the world and, to this day, maintain a peculiar institutional landscape (see Schneider, 2009).

Hence, we should see reflected in the data variations of both economic development and institutional make-up and this is exactly what happens. The clustering algorithm has joined together countries that reflect both similar patterns of development (for instance, Germany and Japan) and similar innovation practices. The cluster that includes both Spain (ranked 26th in innovation by Cornell University, INSEAD and WIPO, 2013) and Turkey (ranked 68th in innovation by Cornell University, INSEAD and WIPO, 2013) illustrates the latter quite well. Within these variations, we have concluded that there are 5 separate type of national innovative behavior, which are analyzed below.

Innovation through Ivory Towers

Cluster 3 is made up of Argentina, Bulgaria, Greece, Hungary, Poland, Romania, Russia and Slovenia. With the notable exceptions of Argentina and Greece, all countries are former soviet republics. The transition from communist to capitalist economies in the 1990s has led the region to acquire many similar traits in their institutional make-up. Among them is the importance of tertiary education, an inheritance of the USRR's insistence on providing higher training to its workforce, especially in engineering, mathematics and other physical sciences (see Åslund, 2007).

Workers in these types of economies are highly educated and possess the basic stones upon which innovation is built. Nonetheless, their economies betray a considerable amount of disconnection between economic actors. There is much less collaboration between universities and industry than other clusters. Also, economies in this group have difficulties in absorbing outside technology, show little degree of cluster formation and face large challenges in solving industry dispute through legal processes.

In other words, cooperation, another fundamental cornerstone of innovative work, is absent. There are likely many reasons for this, be them economic (dependence in relation to multinational corporations – see Nölke and Vliegenthart. 2009), social or political (institutions are still being solidified – see Åslund, 2007). Even universities are not exempt from criticism and some highlight difficulties in adapting their teaching environment to new realities, the lack of research and/or the lack of autonomy in relation to political disputes (see Peréz Lindo, 2002, and Lopez, 2010, for anecdotal evidence). Unsurprisingly, these economies show a lackluster performance in cleantech, notably given the sector's requirement that a multitude of actors participate in research, development, demonstration and commercialization.

In summary, despite their high level of university education, innovation practices reflect a certain amount of isolation. Like the "ivory towers" concept implies, economic actors have tremendous difficulties in establishing efficient venues of cooperation, thereby stunting opportunities of innovative work.

Innovation through Scalability

Cluster 2 is much more heterogeneous and includes a wide variety of countries: Brazil, China, Czech Republic, Indonesia, Italy, Mexico, Portugal, Spain and Turkey. When compared to the previous cluster, they fare better in all criteria studied with the exception of university training.

It is true that this better performance betrays a more cohesive environment for innovation for all economic actors. But, more interestingly, this cluster scores relatively well in commercialized cleantech innovation, defined as "the ability of a country to scale-up innovations developed by cleantech start-ups" (Cleantech Group and WWF, 2012, 24). In other words, these countries are able to significantly increase the use and/or production of technologies, even though they might not be the ones generating the technology.

China illustrates this point very clearly. The manufacturer of the world, its economic growth is based on exporting cheaply made goods designed elsewhere.

Yet, production is not entirely devoid of innovative work. On the one hand, it can constitute a stepping stone towards an innovation-driven economy, as illustrated by Japan's post-war development. On the other, the onset of mass-production requires innovations in management practices, technological processes, equipment usage, logistics, among many others. This is doubly true once we consider that our knowledge-driven economy now requires a level of flexibility which must be reflected, one way or another, on the factory floor.

In summary, countries in this cluster are able to take promising technologies developed elsewhere and produce them in large quantities, resulting over time in reduced costs, better performance and more widespread dissemination.

Innovation through the Fundamentals

Cluster 1 includes countries usually considered CMEs: Austria, Belgium, France, Germany, Japan, Netherlands and Switzerland. Within this group, we find ourselves in the top-performers in innovation.

Knowledge production and technology discovery is given center stage with many universities, research institutions, corporate laboratories and the like pursuing advanced forms of research with clear practical benefits. The knowledge created then slowly seeps into the fabrics of the economy through technical/vocational schools that train and recycle the workforce in very specific skills that are adapted to particular sectors. In that, it mirrors much of what has been discussed about innovation in CMEs where knowledge flows not through the passage of people between companies, but rather through sector-wide agreements on technical standards, technology adoption and research breakthroughs. This particular form of consensus building makes it difficult for individual start-up companies to quickly conquer the market with new products or services.

Japan illustrates this point quite clearly. The country holds the largest number of environmental technology patents than any other country in the analysis (Cleantech Group and WWF, 2012). Yet, its entrepreneurial culture is quite poor, a weakness oftentimes attributed to the rigid structures and expectations found in Japanese culture. Technological breakthroughs usually find their ways into the

large company structures or are forced into widespread adoption by stringent government regulation.

A question arises then as to perceived weaknesses in this form of innovation practice as it is usually argued that a vibrant entrepreneurial culture is a characteristic of highly innovative countries because it is considered the "best" way for technology to find its way to consumers. Yet, countries within this cluster not only enjoy many benefits of new technologies, but also influence, to a large extent, worldwide innovation trends, countering this claim.

We can illustrate this through anecdotal evidence. Toshiba's acquisition of Landis+Gyr, a leading Swiss smart metering company, will likely influence the future development of the smart-grid sector (Cleantech Group and WWF, 2012). The Japanese Top Runner program regularly tightens energy-efficiency standards as soon as a lower power usage level is discovered by a manufacturer. This new level becomes the industry norm and other companies must adapt to it. As a result, Japan has become one of the most energy-efficient countries in the world (Pentland, 2010). Even if its technology is not as readily exported to the outside world in comparison to many other developed countries, the spill-over effect is likely quite large and allows the country to maintain internationally competitive companies.

Hence, countries innovate by focusing on technical skills of the workforce, knowledge transfer through consensus building mechanisms and a focus on applied research (rather than commercialization).

Innovation through Mission Orientation

Cluster 4 includes all LME economies and 3 Scandinavian countries: Australia, Canada, Denmark, Finland, Ireland, Sweden, United Kingdom and United States. Like the previous cluster, this group of countries also scores very high in innovative performance.

Many of the characteristics of LME can be found quite clearly in the data. All have vibrant entrepreneurial cultures where knowledge and expertise flow freely

and that constitute a bridge between the discovery of new technologies and its adoption by the market. Joint ventures and strategic alliances, more so than in any other cluster, are the preferred way of cooperation between economic actors. Venture capital is present in large amounts and searching for the next breakthrough product or service. University, rather than vocational training, is the norm for workforce education and employability in the market place.

Thus far, our model corresponds quite clearly to the established theoretical paradigms of LMEs. Nonetheless, there is one surprising result that has seldom been addressed by proponents of the VoC approach and that is the "mission oriented" philosophy behind the institutions responsible for innovation. The clearest example of a "mission-driven" innovation drive is the efforts of the American government to send a man to the moon, when institutions in public and private spheres were mobilized with this single objective in mind.

Nowadays, such a clear and direct government intervention in the economy is absent, especially when we consider the liberal market views found in LMEs. Nonetheless, the data shows a surprising supporting role of governments towards structuring various drivers, be them private or public, with the objective of fostering technology invention, commercial adoption and company growth.

Cleantech Group and WWF (2012) consider 5 different elements in the criteria "cleantech-specific innovation drivers", the basis for our conclusion on this last point: government policies, public R&D spending, access to private finance, infrastructure for renewables, and cleantech industry organizations. The very nature of cleantech, in that it requires considerable interaction among a variety of difference actors, indicates that a high score in this criterion betrays an important role of government. This role can take on many different guises. The US government, for instance, invests large quantities of money both in R&D and loans for start-ups, while the UK is developing attractive infrastructure for renewables (Cleantech Group and WWF, 2012).

In summary, this cluster represents countries that score very well in innovative performance with a maximum of interaction between economic actors. It is also surprisingly apt at structuring its institutional landscape towards a particular goal,

with the government in a strong supportive role. The playing field government measures create allow for fluid business structures where entrepreneurial start-ups can thrive and disseminate technological breakthroughs throughout the economy.

Innovation through Adaptation?

Cluster 5 is the last grouping in our analysis and constitutes a very eclectic group of countries: India, Israel, Norway, Saudi Arabia, South Africa and South Korea. The variance within each of the criteria considered makes us wonder whether this group in fact represents anything other than a mere statistical oddity given the importance of the variable "legal regime". With the exception of India, all countries' legal regimes are of a mixed nature.

A possible solution to this can be found when we analyze Norway's particular innovation system. Fagerberg, Mowery and Verspagen (2009) state that the country's economic performance is considered a paradox with high income and productivity levels side-by-side with low R&D investment and low performance in other innovation indicators. The solution to this paradox can be found in a few advantages particular to that side of the world. Local companies are able, more so than many other countries, to cooperate among one another effectively towards common innovation goals. They have also developed very good interaction processes with customers, allowing them to better understand the market and hence reduce potential failures. Lastly, they have an incredible "absorptive capacity", a talent to quickly appraise, understand and use new available technologies.

Nonetheless, the explanation given above is quite tenuous because this qualitative interpretation is not reflected in used statistics. For instance, Norway scores incredibly low in knowledge absorption according to Cornell University, INSEAD and WIPO (2013), a result opposite to the solution presented.

In conclusion, this group of countries could be characterized by local firms' capacity at adaptation, interaction with customers and technological/knowledge absorption. Statistical weaknesses in our analysis though lead us to highlight the shaky ground where we stand.

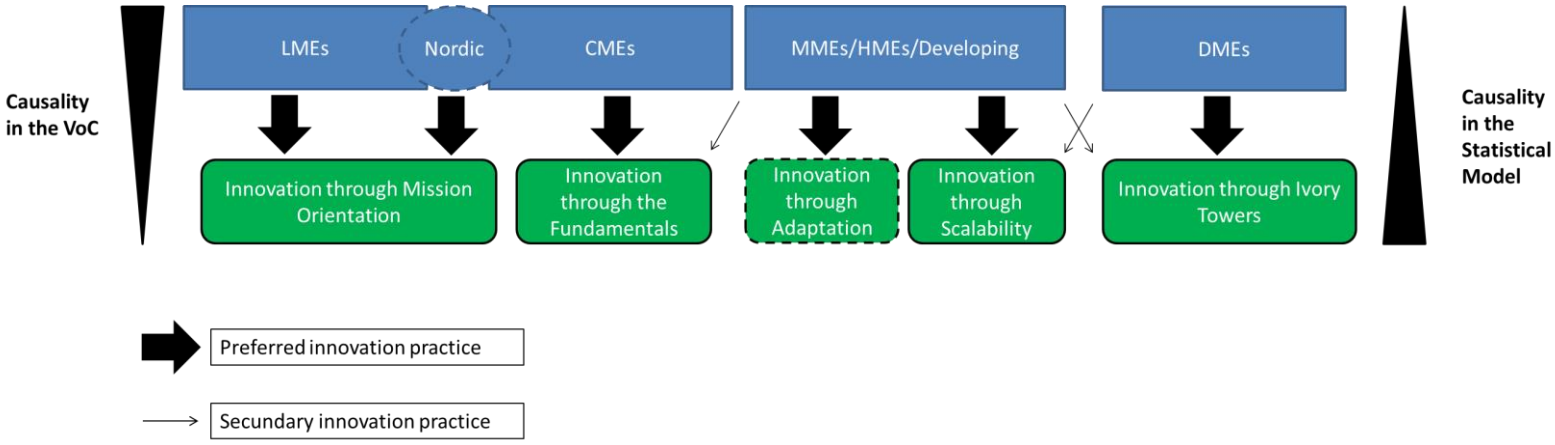
Joining Worlds – VoC and the Statistical Model

There are interesting parallels between the model's results and the paradigms of the VoC approach. Cluster 1 – *innovation through the fundamentals* – joins together economies of a CME nature, while cluster 4 – *innovation through mission orientation* – does the same, but with LMEs (Scandinavian countries being the exception). It does then seem possible to overlap the conclusions of the statistical models with the theoretical musings of VoC researchers.

Causality in the VoC model (see Figure 7) follows institutional advantage to type of innovative behavior. Our statistical model follows an "inverted" causality, from innovative behavior to institutional advantage. The points of overlap between these models should allow us to better qualify practices in the VoC approach, allowing us then to transcend the basic dichotomy of radical VS incremental innovation.

The figure below attempts to visually represent this overlap and shows that most capitalist organizational models favor a particular type of innovative practice. Yet, exceptions to the rules are common enough for us to consider that they can also adopt another, secondary, innovative practice due to variations in institutional make-up.

Figure 7 – Innovation Practice by Capitalist Organizational Model



DMEs follow innovation through ivory towers, while the larger MMEs/HMEs/Developing group follows both innovation through scalability and innovation through adaptation. LMEs prefer innovation through mission orientation while CMEs adopt mostly innovation through fundamentals (see Appendix III for the full model).

VoC and Climate Change

If we focus on the original CME/LME dichotomy, we find that the results better qualify those of Mikler and Harrison (2009) who argue that CMEs are more institutionally capable of disseminating climate-friendly technologies than LMEs. The authors support their claims citing how the automobile industry in Japan and the UE better managed to improve fuel efficiency than in the US. Changes in greenhouse gas (GHG) emissions over the 1990-2006 period are also quite revealing in that CMEs have managed to restrain emissions much better than LMEs.

While we cannot directly conclude on the impact of innovative practices on emission trends (since the cleantech sector is but one of many solutions to climate change mitigation), we can highlight that LMEs approach the problem in a different way and perhaps just as efficiently. While CMEs favor technology dissemination through existing business structure and widespread regulation, LMEs prefer structuring a level-playing field from where a vibrant entrepreneurial culture can be created. As such, the differences alluded to above might be representative of certain sectors' "regulatory capture", rather than institutional advantages towards a certain goal. Obviously, when it comes to directly target emissions, CMEs have an easier time than LMEs. The latter prefer an indirect approach based on fostering certain technological developments, hoping that this will eventually influence the overall GHG trajectory of the country.

This would explain the difference in public climate policy preference between CMEs and LMEs, which the authors state require further study. They show that LMEs are enthusiastically active in research, development and dissemination, as well as public investment. They also favor a range of regulatory measures towards the goal of energy efficiency (a subset of cleantech), something not as common in CMEs. As we have seen, this is not odd at all and clearly reflects the innovation

preferences between the two types of capitalist organizational models. What the authors consider a strange result is perfectly captured in our model.

The Curious Case of Scandinavia

The Scandinavian countries Denmark, Finland and Sweden seem to be the oddity within the LME group of countries (Australia, Ireland, United Kingdom and United States). Disregarding Norway, usually considered a special case within the region (Schneider and Paunescu, 2011; Fagerberg, Mowery and Verspagen, 2009; Hopkin and Blyth, 2004), the results lead us ask how Scandinavia is closely associated with more liberal economies.

A possible explanation is that these countries have adopted LME-like characteristic by imposing more flexibility in labor and capital markets or decentralizing economic decision making. The institutional changes implemented following the crisis of the beginning of the 1990s were substantial and allowed the region to regain economic growth and enjoy a privileged position among the most innovative economies of the world today. For some researchers, these changes have been sufficiently extensive to warrant a change from a CME to a LME status. This would explain the results found in Schneider and Paunescu (2011) where the entire region is characterized as an LME already in 1999.

A second possible explanation follows the reasoning of Campbell and Pedersen (2007) regarding hybrid forms of capitalist organizational models. The region has maintained much of its CME heritage, but has successfully adopted more liberal arrangements, reaching a form of hybridization that has allowed it to adopt innovative practices similar to LMEs. This is an interesting option to consider since it explains how other researchers focusing on more bounded issues find results confirming the original CME/LME dichotomy (see, for instance, Clifton, Cooke and Hansen, 2011, for knowledge workers' location dynamics in Sweden and the UK).

An interesting corollary is that, contrary to what is expected from the theory, a hybrid form of capitalism allows as adequate, if not better, a result (speaking solely in terms of innovation) than a purer type. The institutional changes alluded

to above have allowed the region to update its model while keeping true to its nature (Hopkin and Blyth, 2004). Even today, the region is lauded for the high level of coordination among social actors and the state (Jo Martin, 2012) with recent changes seen as an adequate response to an era of constrained resources, globalization and growing diversity (The Economist, 2013).

A final possibility is that LME economies have adopted CME-like characteristics in their innovation efforts. This is not as unlikely as might sound. The United States government has had a fundamental role to play in variety of technological developments, most notably information technology (Fabrizio and Mowery, 2007). While its participation was due to the specific context of the Cold War, to this day, it is a fundamental player in defense related technological investments, an element frequently ignored by researchers of capitalism (Crouch, 2005).

Desatnik (2011) recently argued that cluster formation was a response typical to cooperation challenges between economic actors within the liberal environments of LMEs. It is not too difficult to consider that, facing coordination challenges within large technological systems such as those found in cleantech, the government would participate in common efforts through a supporting role. This would allow LMEs to adopt many of the advantages found in the Scandinavian region. Cleantech Group and WWF (2012), for instance, note that some LME economies have a strong public participation in cleantech, be it in the form of public investment (Australia, US) or infrastructure development (UK). The exceptions of Canada and Ireland, that have low or moderate government participation in this particular technology, might be considered a possible counter-point to our argument.

In conclusion, there are 3 possible interpretations to the reason that Denmark, Finland and Sweden find themselves in the LME grouping. Unfortunately, the model cannot clearly state which one is the most adequate and we leave this question open for future debates.

5.3 General Summary of Results

Our original research questions focus on two separate, yet linked issues. The first regards whether the VoC approach still holds when innovation is explicitly considered in the segmentation data. There are, as presented above, a large amount of nuances in the answer, but the general answer is *yes to a large extent*. LME and CME countries find themselves in two groups as expected by the original Hall-Soskice theorem. They engage in innovation strategies that are particular to their own type of capitalist organizational model, making good use of their respective institutional advantages. Our paper has further analyzed innovation practices of countries outside this dichotomy and seems to reproduce very many consistencies with already existing theories. For example, DMEs all find themselves in a single group and share similar innovation practices. Nonetheless, the VoC approach outside the original CME/LME dichotomy is not as structured. Although we find certain regularities among different groups of countries, this should not hide the on-going debates existing in the use of the VoC framework to countries outside of the OECD region.

The second issue deals with what the study has unearthed when innovation becomes the central theme of analysis within the VoC framework and 2 findings are particularly interesting to highlight. First and foremost, government is an essential actor in innovation work in both CMEs and LMEs, groups at the frontiers of technological breakthroughs. This is surprising for LMEs as the original theorems characterizes government as an actor of arms-length distance with other social and market elements. Surprisingly, the government is essential in structuring the different actors within a specific sector (cleantech, in our analysis) towards a specific goal (substantially increasing the use of clean technologies by society). The United States is a good example of this with its heavy support of public research in clean technologies. And, while it is true that the provision of a public good is an expected action of government, such actions can potentially lead the sector towards specific long term goals and foster a determinate response by economic actors by conditioning the use of new breakthrough technologies.

Secondly, the Scandinavian countries add an interesting dimension to the results of our analysis. Their presence in the LME grouping raises questions that cannot be solved in this paper. For one, it can be that the region has adopted sufficient

LME-like characteristics for the countries to have become wholly liberal market economies. A second alternative is that the region has adopted LME-like characteristics through a process of hybridization that generate an equal or more efficient results in innovative work than in purer types. A final alternative is that LME economies have adopted CME-like characteristics, making the whole group resemble the Scandinavian region and not vice versa. We call on the reader to decide or explore which alternative is more appropriate.

5.4 Limitations of the Analysis

It is never too much to stress that much of the data used has an implicit gradation of low innovation performers to high innovation performers according to a set of values that stress certain behaviors over others. As such, within this mindset that, for instance, privileges venture capital as the most adequate investment instrument to disseminate breakthrough technologies, statistics are compiled to show the extent to which a particular system is close to an optimal level. This is done irrespective of whether the country's institutions are, in fact, compatible with this optimal level, a situation further complicated by countries' varying level of economic development.

The implicit assumption in almost all of the statistics used imply that there is solely one way to approach innovation and countries compare according to how well they maintain this path. The practical result of this is that conclusions are derived from minimal variations between criteria, a method with dubious statistical explanatory power.

A second challenge stems from the sectoral focus of the data. While cleantech includes a variety of different technologies, the vast majority is made up of energy related products and services. This specific sector is particularly dependent on interactions between a very wide array of actors, both public and private. Government is an important element in the decision making processes and cannot easily be restricted only to its regulatory role. Hence, the results found are perhaps not applicable to other sectors where the government can potentially have a lesser influence on its structure.

A final difficulty in the analysis comes from our assumptions and deals with the question of whether or not there is really something there. We assume that countries innovate in different ways and use the data to defend this position. But, should the assumption prove false in that innovation practices are not actually very different between countries, then our whole model falls apart. That innovation systems differ among nations is a given considering the breadth of actors that participate in innovation efforts. Nonetheless, to assume that there are patterns in how specific groups of countries innovate is an assumption and one we should be conscious about.

Conclusion

The original Hall-Soskice Varieties of Capitalism framework described two main types of capitalist organizational models: Liberal Market Economies and Coordinated Market Economies. While the former are adept at radical innovation in the form of completely new products or services, the latter excel at incremental innovation in the form of small improvements in existing products and services. The distinction between radical and incremental innovation was common up to the end of the 1980s and still influences researchers to this day. Nonetheless, there are many difficulties in applying this concept to an entire sector let alone an economy. Various critics have highlighted the conceptual challenges in the dichotomy, as well as the fact that statistical tests do not confirm it.

It is our understanding that the use of the radical and incremental concepts is inadequate and does not reflect recent advances in the academic knowledge of innovation. In order to better qualify innovative practices throughout the world, we have opted to create a particular model that includes concepts from the VoC framework and an "anchor" in the form of a specific high-tech sector: clean technology. The model's results are interesting in that Coordinated Market Economies and Liberal Market Economies have specific innovation patterns, each unique to its own style of organization. CMEs' innovative practices – what we called *innovation through the fundamentals* – rely heavily on applied research and favor technical training over general one, with knowledge transfer guaranteed through sectoral negotiation instances that gather companies, research centers,

unions and government. They show a particular advantage at spreading new found technologies through existing business structures, thus allowing large companies to maintain worldwide competitiveness and influence international innovation trends.

LMEs (alongside Denmark, Finland and Sweden) approach innovation through different lenses. Their specific practice – what we called *innovation through mission-orientation* – favor strategic cooperation between companies in the form of strategic alliances and joint ventures. Venture capital is quite developed and constantly searching for the next breakthrough product or service. Knowledge flows through the economy thanks to a more dynamic movement of specialized employees. What is surprising with countries adopting this type of innovative approach is the way with which it structures its economy towards a specific goal, a structuring characterized by strong government support. Despite common perception about LMEs, the government is an essential actor in technological discovery and dissemination, and while its support varies from country to country, it is essential in guaranteeing that the country stays in the frontiers of technology.

Like many researchers before us, we believe that the VoC approach highlights the need to understand the institutional make-up of an economy prior to giving economic advice. Innovation, in particular, is an incredibly complex area and no one-size fits all policy can do justice to its multi-faceted reality. In a world where the financial crisis dominates media headlines and governments tighten their budgets, it is never too much to stress the structural role played by the public spheres. While we do not defend runaway budget deficits nor government-led technology discovery and dissemination roadmaps, our results do imply that government is an essential element in maintaining a country at the technological edge. Less government participation can only be justified once it does not lose its positive structuring role, adapted to the specific conditions where it governs. Were we to focus exclusively on cleantech, government participation, be it direct financial transfer in the form of loans for start-ups or public R&D (as in the US), infrastructure development (as in the UK) or aggressive support policy (as in Germany or Denmark), seem a necessary pre-condition for technological dominance.

Our findings can be considered surprising, yet we must be wary of the weakness in our analysis. The statistical model has a variety of flaws, from the quality of the inputs to the steps taken to analyze the mathematical results. While the findings may hold true in the cleantech sector, where government is, at the very least, a strong regulatory force, there is little in our analysis to support the conclusion that they may hold true for other sectors. Furthermore, other clustering algorithms may show further surprising results, including perhaps the absence of any real relationship between certain innovation practices and capitalist organizational models.

Despite it all, we hope to have given a small step towards transcending the dichotomy of radical and incremental innovation found in country-wide institutional analysis. Innovation is a complex phenomenon that should not be reduced to this simple binary distinction. In a world of increasing complexity and richer inter-relations between economic actors throughout the world, innovation should be a strong focus of policy making. Success in this endeavor will come through many elements, not least of which an adequate set to tools – from academia, government and businesses – needed to comprehend and influence the reality around us.

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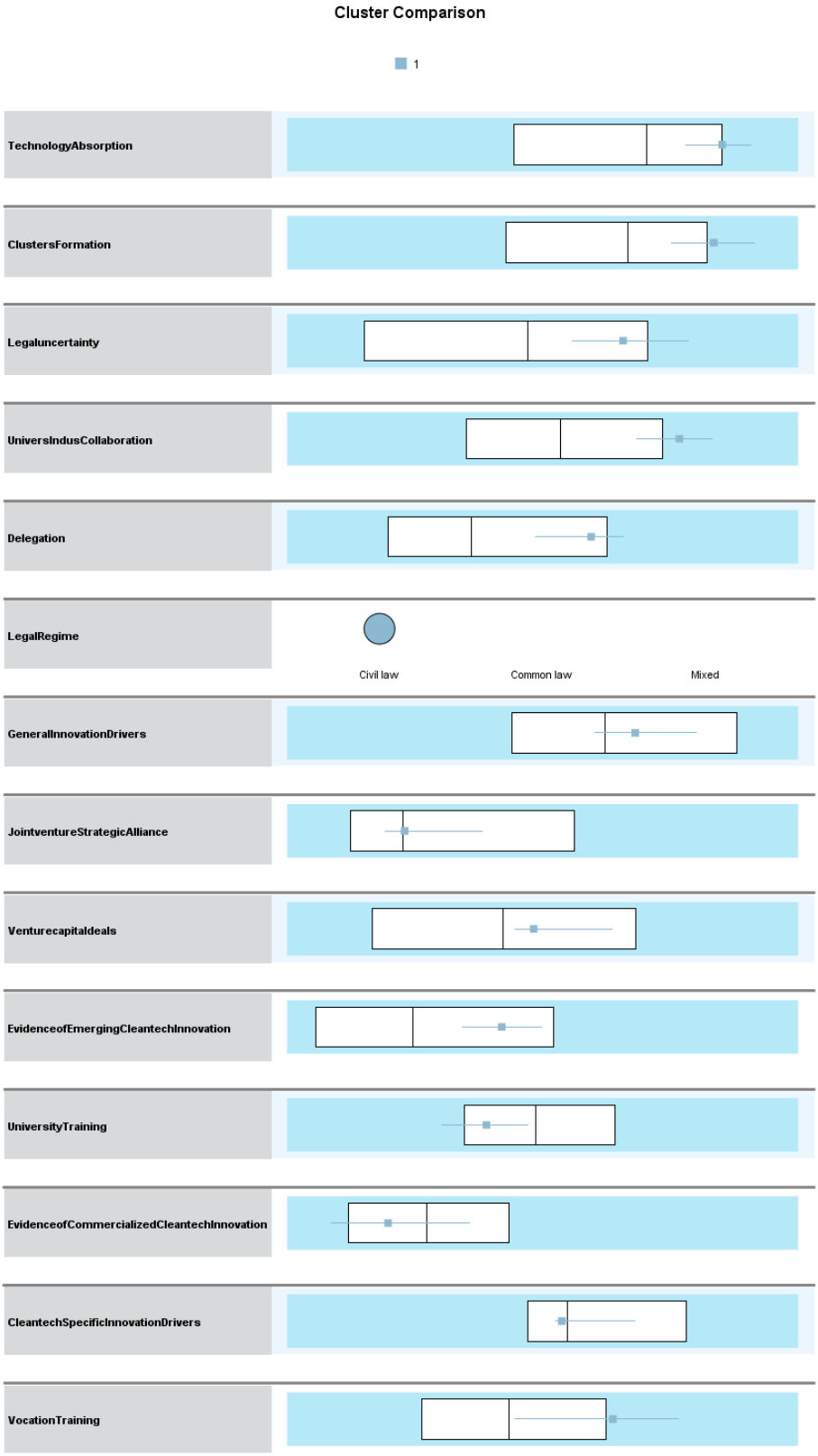
Appendix I – List of Countries in the Study

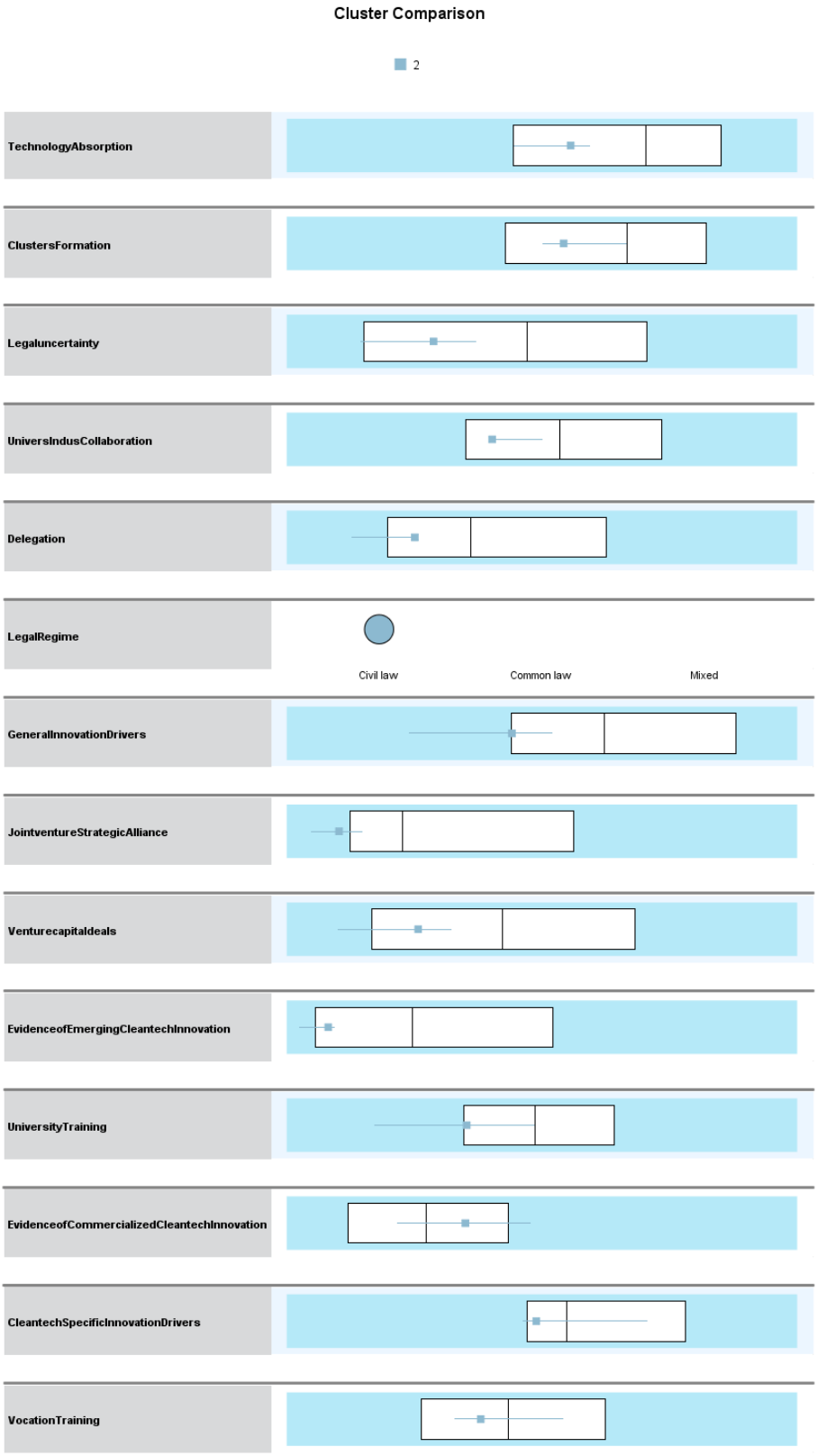
Argentina	Greece	Romania
Australia	Hungary	Russian Federation
Austria	India	Saudi Arabia
Belgium	Indonesia	Slovenia
Brazil	Ireland	South Africa
Bulgaria	Israel	South Korea
Canada	Italy	Spain
China	Japan	Sweden
Czech Republic	Mexico	Switzerland
Denmark	Netherlands	Turkey
Finland	Norway	United States
France	Poland	United Kingdom
Germany	Portugal	

Appendix II – Results of the Statistical Test

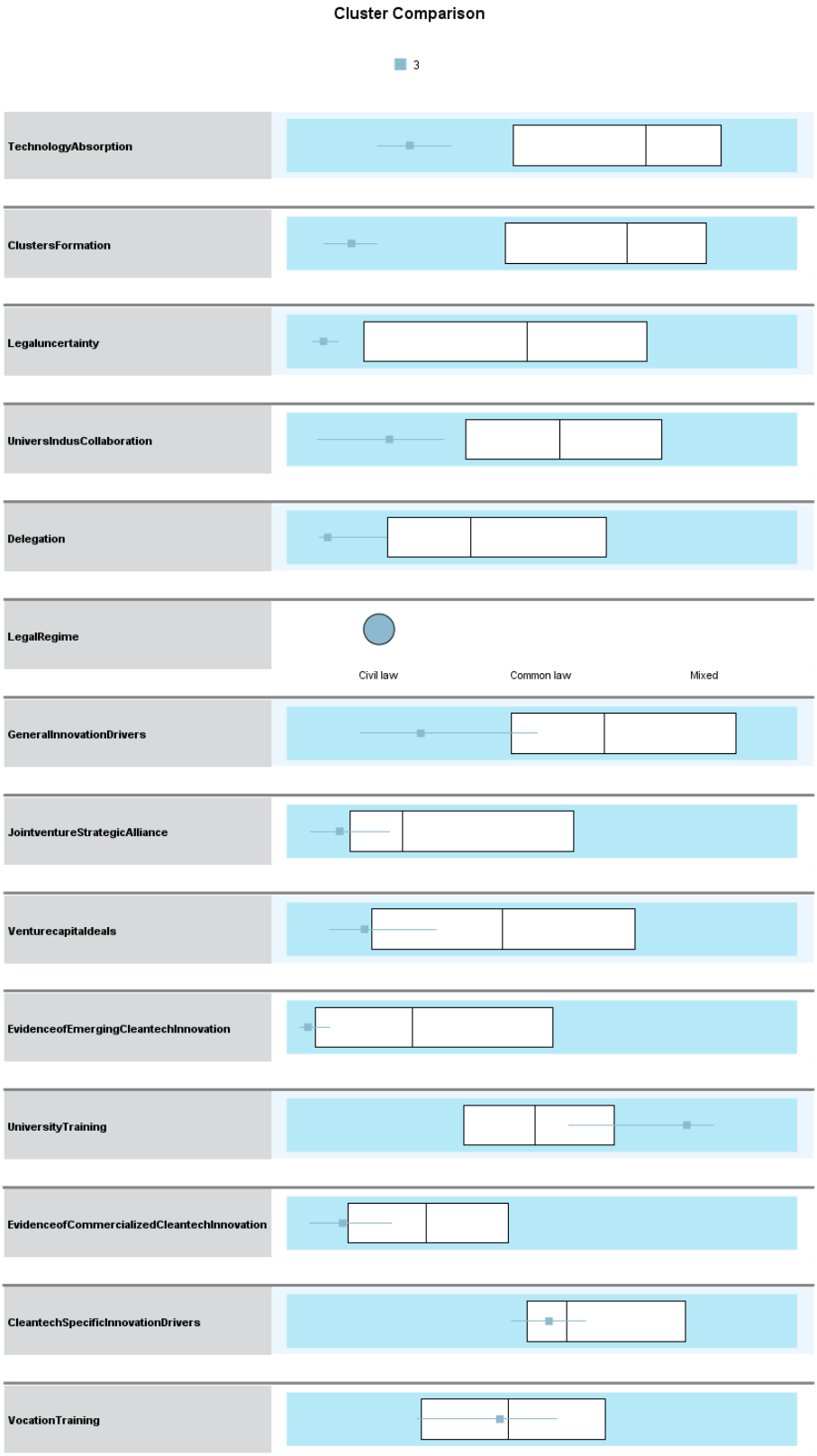
Cluster 1 – Innovation through the Fundamentals



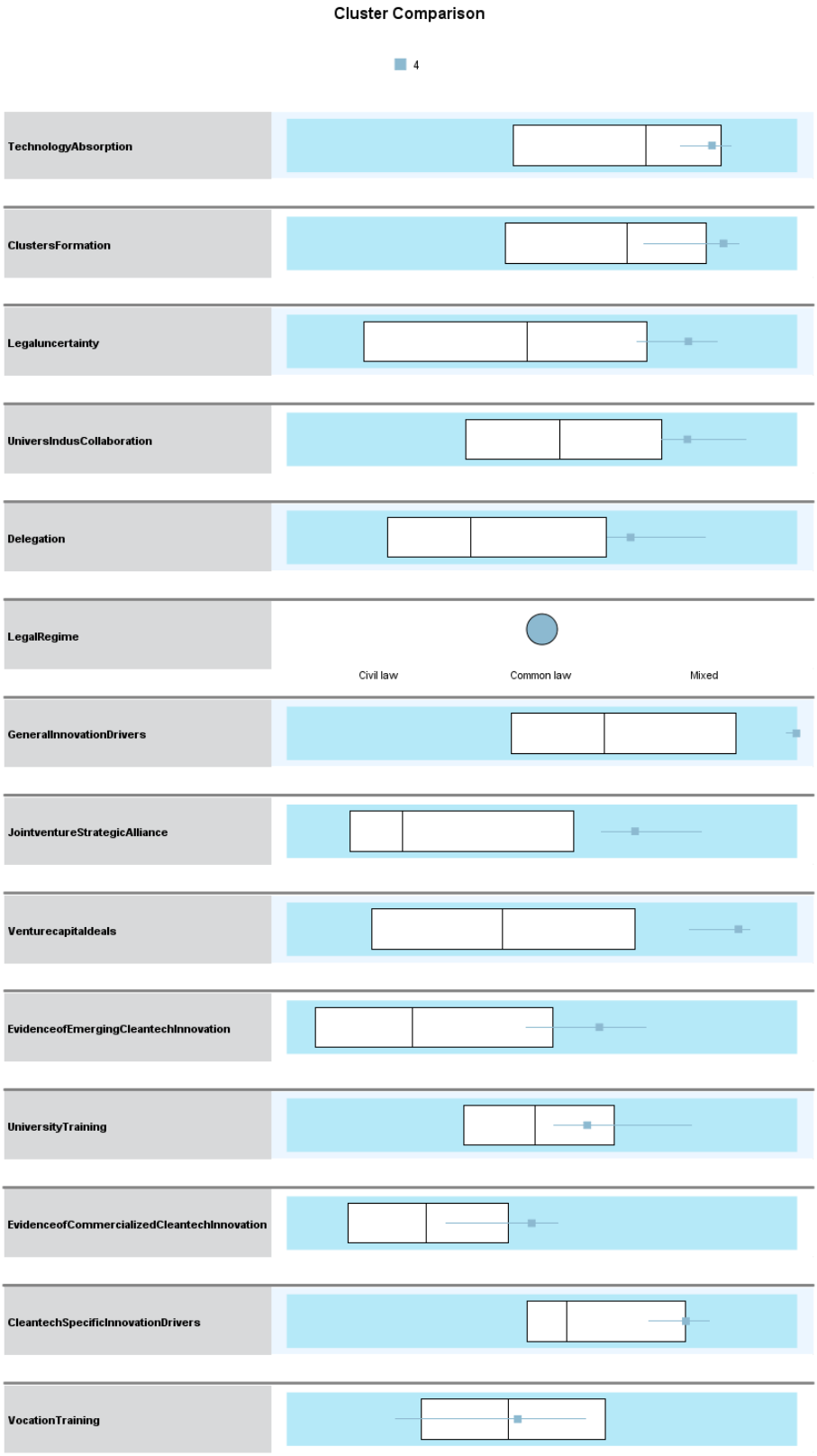
Cluster 2 – Innovation through Scalability



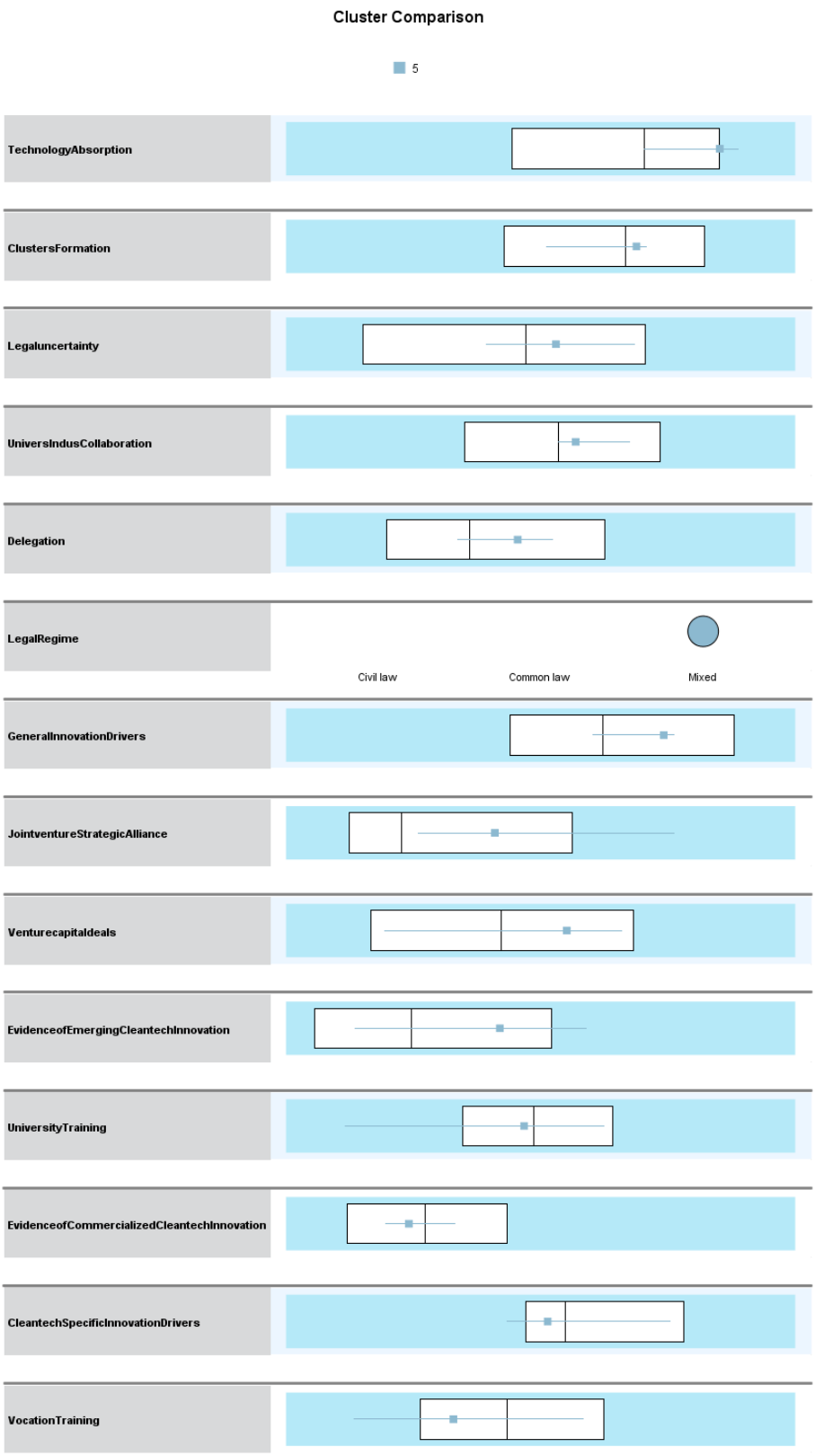
Cluster 3 – Innovation through Ivory Towers



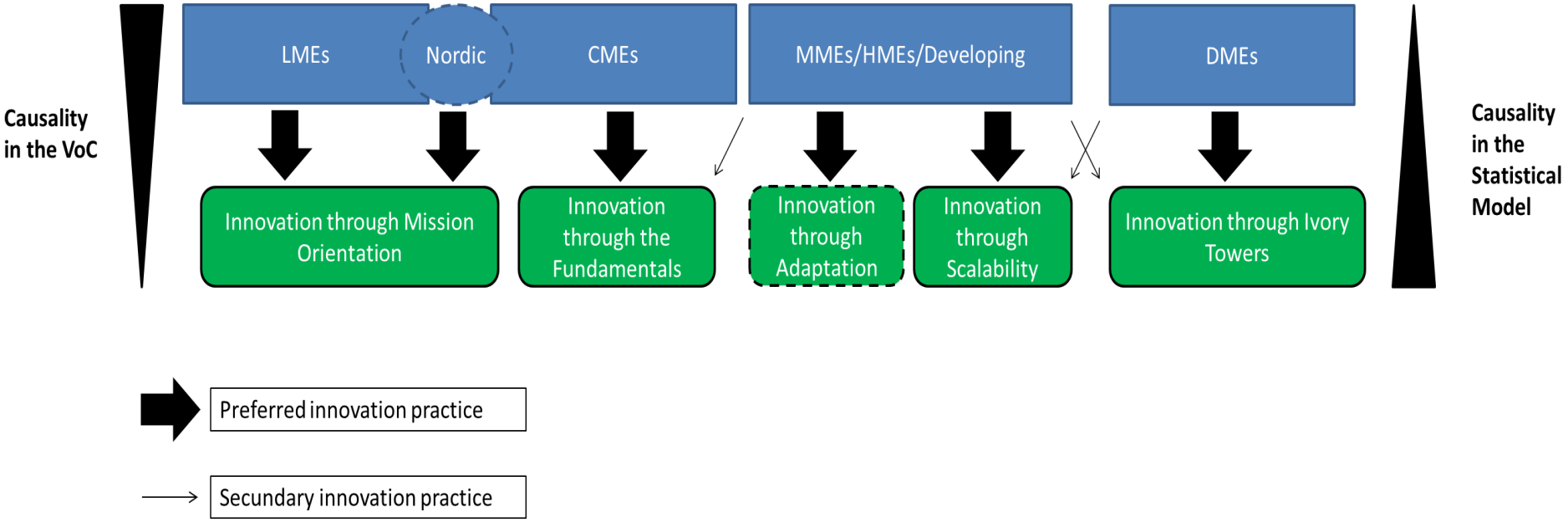
Cluster 4 – Innovation through Mission Orientation



Cluster 5 – Innovation through Adaptation?



Appendix III – Complete Model of Conclusions



LMEs	Nordic	CMEs	MMEs	HMEs/Developing	DMEs
Schneider and Paunescu (2011)		Schneider and Paunescu (2011) and Hall and Soskice (2001)	Schneider and Paunescu (2011)	Schneider (2009)	Nölke and Vliegenthart (2009)
Australia Canada Ireland UK US	Denmark Finland Sweden	Austria Belgium France Germany Netherlands Switzerland	Israel Italy Japan Greece Norway Portugal South Korea Spain Turkey	Argentina Brazil China India Indonesia Mexico Saudi Arabia South Africa	Bulgaria Czech Republic Hungary Poland Romania Russia Slovenia

Innovation through the Fundamentals	Innovation through Scalability	Innovation through Ivory Towers	Innovation through Mission Orientation	Innovation through Adaptation
Austria Belgium France Germany Japan Netherlands Switzerland	Brazil China Czech Republic Indonesia Italy Mexico Portugal Spain Turkey	Argentina Bulgaria Greece Hungary Poland Romania Russia Slovenia	Australia Canada Denmark Finland Ireland Sweden UK USA	India Israel Norway Saudi Arabia South Africa South Korea