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Is there an Asian model of technological emergence?

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Emerging countries (ECs), and notably Asian ones, are challenging Northern countries in the technological field. Using an application of the Social System of Innovation and Production (SSIP) framework, we carry out a two-step analysis to compare the socio-economic models of technological upgrading of 27 ECs in 2005. Searching for a typical Asian model, we observe that the eight Asian ECs in our panel are dispersed among four of the five types of emerging capitalism. Although Asian ECs belong mainly to the directed model, three exceptions are observed: South Korea has a de-centralized model, Malaysia a finance-led model and the Philippines a cocktail model. This diversity of institutional architectures in Asian ECs does not prove that there is no Asian mode of upgrading but rather that an Asian path towards technological emergence does exist, followed by Asian ECs at different periods and at varying speeds.

Keywords: Asia, variety of capitalism, developing countries, institutional complementarity, internationalisation, technological change
JEL classification: P51 comparative analysis of economic systems, C38 classification methods, cluster analysis, factor models, O33 technological change: choices and consequences, diffusion processes

1. Introduction

The most successful examples of rapid industrialization have occurred in Asia. Japan and, more recently, the Four Asian Tigers (Hong Kong, Singapore, South Korea and Taiwan) followed the late development model and can no longer be considered as developing countries (Amsden, 1992, 2001). Today, economists are interested in 'emerging' countries (ECs), broadly defined as those countries that are offering a new challenge to Western hegemony on several levels. If there is neither a commonly agreed definition nor a list of ECs, there is a large consensus on the fact that they have differentiated themselves from developing

countries, since the beginning of the 1990s, because of their rapid growth and their accelerated economic, financial and technological insertion into the world economy. This last dimension is of particular interest because ECs are threatening developed countries' leadership in the creation and production of technology.

While the share of world exports of high-technology products is declining for the Triad (from 77% in 1990 to 45% in 2010), ECs are progressively becoming key suppliers in these hitherto protected markets (from 9% in 1990 to 40% in 2010) (CEPII, 2012). Asian ECs (30% of the ECs) are the main challengers of the old industrialized countries as they account for ∼80% of ECs technological exports. This geographical reorganization of world production cannot only be attributed to their cheap workforce, since innovation is also concerned. ECs are privileged destinations for R&D expansion: in an UNCTAD survey, 16 of the 33 countries most often cited as preferred R&D destinations are emerging ones (UNCTAD, 2005). But there again, Asian ECs stand out as future technological leaders: China is in first place and India in third. Some authors are even speaking of 'Asian drivers of global change' (Altenburg *et al.*, 2008). This 'Asian miracle' could reveal the existence of an Asian path towards emergence, led by technological upgrading. We have thus decided to study emergence through this technological prism because upgrading in the global value chain constitutes a main driver of their global development process.[1]

In this article, we seek to verify whether technological emergence is specific to Asian ECs. In this respect, we question the existence of an Asian model of emergence and try to understand the institutional architecture(s) that sustain(s) Asian ECs outstanding technological upgrading. Have Asian ECs developed a specific institutional arrangement which sets them apart from other ECs?

Analyses of National Innovation Systems (Lundvall, 1992; Nelson, 1993; Freeman, 1995) allow the study of innovation as a process involving a multitude of interacting actors engaged in a broad institutional network. The technological environment as a whole orientates countries' technological style. This framework should be helpful to understanding the building up of technological capabilities in ECs, but it is mainly used to produce monographs. As we want to put socio-economic models of ECs into perspective, we consider a comparative institutional analysis.

This approach allows the identification and the description of the diversity of existing socio-economic models and has mainly been used to compare countries' models of capitalism. The 'variety of capitalisms' approach initially distinguishes two forms of capitalism in OECD countries: 'Liberal Market Economies' and

[1]Technological progress has long been considered a major growth factor, as borne out by growth theories (Solow, 1956) endogenous growth theories (Romer, 1990), evolutionist theories (Schumpeter, 1939; Nelson and Winter, 1982) or diffusion theories (Gerschenkron, 1966; Abramovitz, 1986).

'Coordinated Market Economies' (Hall and Soskice, 2001). This dualist view of types of capitalism masks the great diversity of institutional architectures existing in developed countries and some authors (Amable, 2000; Amable and Petit, 2001) identify at least four distinct models of capitalism. A recurrent criticism made of these two alternative branches of comparative capitalism is that they focus only on OECD countries. In order to make up for this lack, some recent publications bring developing countries into the analysis: Latin America (Sanchez-Ancochea, 2009; Schneider, 2009; Schneider and Karcher, 2009; Schneider and Soskice, 2009) and Central and Eastern European (CEE) countries (Berrou and Carrincazeaux, 2005; King, 2007; Mykhnenko, 2007; Nölke and Vliegenthart, 2009) have received recent attention. This work should be pursued, in particular bringing Asia into the comparisons.

We wish to contribute to the achievement of this objective. Because we consider technological emergence as a central and distinctive feature of a more global economic emergence process, we apply the Social System of Innovation and Production (SSIP) framework to ECs. Borrowing from literature on both Innovation Systems and diversity of capitalism models, the notion of SSIP (Amable *et al.*, 1997; Amable, 2000) attempts to give an analytical grid for the study of the determinants of technological change in an institutional environment. The authors assert that different institutional arrangements produce a large variety of 'institutional comparative advantages' that shape national development trajectories. Application of this framework to ECs can thus enrich our comprehension of the paths towards technological emergence and of the (hypothetical) specificities of the Asian path.

Using an application of the SSIP framework, we carry out a two-step analysis to compare the socio-economic models of technological upgrading of 27 ECs in 2005. Searching for a typical Asian model, we observe that the eight Asian ECs in our panel are dispersed among four of the five types of emerging capitalism. If Asian ECs belong mainly to the directed model, three exceptions are observed: South Korea has a de-centralized model, Malaysia a finance-led model and the Philippines a cocktail model. This diversity of institutional architectures in Asian ECs does not prove that there is no Asian mode of upgrading but rather that an Asian path towards technological emergence does exist, followed by Asian ECs at different periods and at varying speeds.

The article is organized as follows. Our framework is presented in Section 2. Section 3 presents our empirical results and Section 4 introduces a discussion on the existence of an Asian path towards, rather than a model of, technological emergence.

2. A methodology for putting Asian model(s) of technological emergence into perspective

Various institutional architectures can achieve comparable performances, and rapid technological upgrading of ECs could thus be supported by alternative socio-economic models. To observe and understand Asian ECs' institutional architecture(s) and its(their) hypothetical specificities relative to other ECs, we carry out cross-national comparison, applying the SSIP analytical grid to ECs. This transposition of SSIP's original area of application to ECs implies some adaptations. This section details the scope of comparison, framework, database and method of analysis which we implement hereafter.

2.1 A large panel of technologically comparable ECs

When integrating ECs into analyses, Variety of Capitalisms studies presuppose geographical homogeneity. They observe Latin American or CEE ECs' institutional architecture relative to the OECD's two ideal-types. Proximities and differences in coordination modes are sought between ECs' configurations and 'Coordinated Market Economies' or 'Liberal Market Economies'. In doing this, a third form of capitalism is introduced: 'Hierarchical Market Economies' to describe Latin American ECs (Schneider, 2009) and 'Mixed Market Economies' (Mykhnenko, 2007) or 'Dependant Market Economies' (Nölke and Vliegenthart, 2009) for CEE countries.

If these studies provide an answer to the scarcity of characterization of developing countries' institutional profiles, they lack an objective consideration of diversity. ECs from the same geographical area are considered *ex ante* to have the same institutional architecture and no intragroup heterogeneity is envisaged. Similarities between observed ECs are over-estimated since comparisons are made with developed countries. It would have been interesting, for example, to look at Latin American ECs alongside CEE ECs to establish geographical homogeneity and to test the *a priori* institutional distance between 'Dependant Market Economies' and 'Hierarchical Market Economies'.

To overcome these weaknesses, it is essential to integrate all comparable ECs (Latin American, Asian, European and African) into the analysis simultaneously. Since we want to observe the diversity of institutional structures sustaining technological upgrading, we opt for a selection of ECs based on two successive criteria: GDP per capita lower than that of countries classified as high-income countries by the World Bank in 1990; among these developing countries, ECs

are those whose exports of high- and medium-high technology[2] to high-income countries in 2005 are above the median of developing countries. Only countries that were initially backward and that have now reached high levels of technological performance thanks to the emergence process meet these criteria. This technological definition of ECs results in the selection of 27 countries which are so competitive that they are becoming the new challengers of developed countries, even in the latters' own markets and for hitherto protected technologies[3]: Argentina, Brazil, Bulgaria, Chile, China, Czech Republic, Estonia, Hungary, India, Indonesia, Malaysia, Mexico, Morocco, the Philippines, Poland, Romania, Russia, Slovak Republic, Slovenia, South Africa, South Korea, Thailand, Tunisia, Turkey, Ukraine, Venezuela and Vietnam.[4] This large panel of technologically comparable ECs allows for multiple sources of diversity. Countries with relatively different levels of economic development will be studied. The inclusion of South Korea in this ECs group, for example, allows us to observe whether or not its great success has its roots in a very specific institutional arrangement. Geographical institutional homogeneity can also be tested since different continents are considered. It will, for example, be very interesting to see whether Asian ECs adopt the same institutional architecture as their regional model, South Korea.

2.2 *Applying the SSIP framework to emerging countries*

To provide a global analysis of the diversity of socio-economic models of technological upgrading, we apply the SSIP framework to ECs (Amable *et al.*, 1997; Amable, 2000). With a theoretical analysis, the authors isolate the three central institutional domains which influence a country's technological style: (S) the scientific sub-system, which creates new ideas, (T) the technological system, which transforms those ideas into artefacts, (I) the industrial system, which converts

[2]*High-technology products*: medical and optical instruments; pharmaceuticals; radio and telecommunications equipment; information technology; manufacture of aircraft and spacecraft *Mid-high technology products*: railroad and transport equipment; motor vehicles and trailers; electrical and household appliances; machinery; chemical products (except pharmaceuticals) (CEPII, 2012).

[3]Our selection is very similar to existing lists of ECs (FTSE, MSCI, CEPII, Bureau Van Dijk, Boston consulting Group, Crédit Agricole, Standard & Poor's, IMF, Emergence Consulting room, UNCTAD). The most often cited countries (minimum of three citations on the ten lists) are by a large majority (80%) in our list too. Whatever the dimension of emergence studied, the selected ECs are mainly the same. This supports the idea that emergence is a global process and that modernization occurs simultaneously in several fields of economics.

[4]Although it meets the two selection criteria to be classified as EC, Taiwan has been removed from the database. It is indeed not classified as an independent state by the World Bank (but administrated by China) and the consecutive lack of data does not permit a reliable analysis.

those artefacts into marketable products. The authors then recommend the analysis of three additional domains which have a strong influence on the efficiency of the S–T–I interaction: (E) the education and training system which provides skills for the labour force, (F) the financial system, which contributes to the orientation of innovation and production dynamics, (H) the human resources system, which reflects the composition and the degree of flexibility of the labour market. The empirical implementation of this SSIP method consists of the constitution of a large database for each institutional domain and its exploration by means of factorial analysis methods. The authors identify complementarities among domains and conclude with the existence of four institutional configurations within OECD countries: the market-based SSIP, the mesocorporatist SSIP, the European SSIP and the social-democratic SSIP.

This framework meets our purpose of identifying the diversity of institutional architectures supporting the technological performances of ECs. More specifically, the statistical treatment adopted can provide an objective observation of ECs' socio-economic models with no *a priori*. The pure observation of data allows us to test Asian geographical institutional homogeneity. If Asian ECs share a common institutional structure, based on strong complementarities, then we could conclude that there is an Asian model of technological emergence. It would also be of interest to observe how other ECs are structured and to question the existence of a plurality of coherent models.

Although the SSIP framework enables this kind of problem to be studied, it has been developed in order to compare the SSIPs of developed countries and needs to be adapted to the specific requirements of ECs. We cannot simply suppose that ECs' innovation systems are comparable with those of developed countries. First, they suffer systemic failures, i.e. 'the inability [. . .] to support creation, absorption, retention, use and dissemination of economically useful knowledge through interactive learning or in-house R&D investments' and can be characterized as 'emerging innovation system[s] [as] only some of [their] building blocks are in place and [as] the interactions between the elements are still in formation' (Chaminade *et al.*, 2009, p. 361). ECs' innovation systems particularly lack in-house R&D and university-company networks for innovation (Chaminade and Vang, 2008). Mezouaghi (1999, 2002) proposes the substitution of the concept of National Innovation Systems with that of National Absorption Capacities and Viotti (2002) with that of National Systems of Absorption to analyse the learning process within developing countries. The even greater success of Asian countries is based on the construction of 'indigenous technological capabilities' to assimilate imported technologies (Kim, 1980, 1997). Technological upgrading in ECs thus relies more on DUI (Doing-Using-Interacting) learning (Lundvall *et al.*, 2009) and then on imitation, adoption and adaptation than on innovation *sensu stricto*.

Since the creation of ideas that are new (to the world) is sporadic in ECs and since technological progress relies more on innovation new to the firm or new to the country, we merge the scientific and the technological domains in our adapted SSIP framework to reflect technological creation in ECs.

Secondly, the development of technological capabilities in ECs relies on networking with innovation systems of developed countries since the reinforcement of those capabilities is supported by the maximization of learning opportunities (Lall and Pietrobelli, 2005). International integration provides access to world knowledge and technologies, and could then accelerate their diffusion (Bès, 1996; Mezouaghi, 1999). Technological spillovers from industrialized countries can even be more growth-enhancing than internal R&D (Diao *et al.*, 1999). Moreover, integration of national innovation systems into global knowledge networks, through the bridging role of multinational companies' subsidiaries, boosts transfers of skills, knowledge and technology (Marin and Arza, 2009). If Arocena and Sutz (2000, 2005) underline that technological dependence of *neo-peripheral national innovation systems* could slow down, if not block, the endogenous process of technological creation in developing countries and their consequent upgrading, the positive effect of international integration is notably fundamental for ECs which have developed their technological capacities so as to be able to benefit from world knowledge (Kim and Lin, 2009; Fu *et al.*, 2011).

Since it is a constitutive dimension of emergence, all the more so in a period of exacerbated globalization, we add an 'international integration' domain to the original SSIP framework.

The application of the original framework allows the study of Asian specificities in relation to other, comparable ECs. Finally, our analytical framework for studying emerging socio-economic models of technological upgrading is made up of six complementary institutional domains: scientific and technological, industrial, human resources, educational, financial and international integration.

2.3 Database

No synthetic variable offers enough information to precisely understand the existing configurations of institutional domains which enable such rapid upgrading. Satisfactory characterization of each domain thus implies the analysis of a great variety of indicators chosen to accurately reflect EC specificities. To this end, we have constructed an extensive database consisting of variables collected from different sources. The data set aims at being as faithful as possible to the one used in Amable (2000). The construction of the final database used in this paper has required an extremely careful approach, as it is specifically designed for the study of ECs. Multiple sources have been consulted and combined (when global coherence of data was not threatened) in order to deal with the

recurrent issues encountered when working on ECs, e.g. missing or incomplete values. A thorough process of selection and testing has resulted in 80 variables for 27 ECs being retained for the year 2005.[5] The final data set retained is the one that contains the greatest explanatory power, as measured by the global percentage of variance explained. It therefore constitutes an innovative basis for the study of institutional profiles in ECs.[6] It mixes purely institutional measures (reflecting legal rights and rules, procedures or enforcement) and performance indicators used as proxies for institutional evaluation. The indicators (and sources) selected for each domain are detailed in Appendix 2. Key conceptual issues to be taken into account in each institutional domain are presented below.

Scientific and technological systems are described by 11 variables, showing incentives, the involvement of different actors, inputs for S&T production, as well as outputs of the system and their uptake by the population. *Industrial systems* include 13 indicators of national productive structure, the degree of state involvement in economic activity and many regulatory variables evaluating the business climate. *Human resources systems* (16 variables) can differ in their structure (for instance the proportion of salaried workers, of vulnerable employees or of women), in employment protection and in the nature of the employment relationship. *Education systems* (17 variables) are characterized by the overall educational level of the population, the quality of schools, their specialization, internationalization, and the involvement of the different actors in skill creation (private and public sector, firms). *Financial systems* are differentiated by their orientation towards banks or financial markets, their openness to foreign capital and the institutional incentives to develop the financial sphere (12 variables). Finally, *international integration* is depicted by countries' openness to trade and investment, participation in global value chains and institutional arrangements encouraging or prejudicing trade (11 variables).

Every variable of the initial database is then corrected for outliers.[7] Since our analysis is based on comparative methods, it is not the value of the gap between countries that matters, but only their relative position. Therefore, it is possible to bring outlying countries closer to the main group without altering the classification. This is done by manually forcing the outlying values to have a maximum

[5]When data observations are missing, we have used the closest data before or after the reference year or, when possible, we have made an extrapolation (linear interpolation) from available data. This strategy seems appropriate since we use mainly structural variables which are relatively time-independent.

[6]This database has been partially used in the ICaTSEM project, a project granted under the FP7 framework.

[7]A country observation is considered as an outlier if its value exceeds (or is inferior to) three times the inter-quartile range from the upper (or lower) quartile, i.e. if $x_i > (Q_{75} + 3 \times (Q_{75} - Q_{25}))$ or if $x_i > (Q_{25} - 3 \times (Q_{75} - Q_{25}))$.

distance from the main group of one standard deviation. This correction prevents the analysis from being blurred by the weight of a single country.

2.4 A two-step methodology

The empirical method—to propose and understand a typology of emerging socio-economic models for technological upgrading, and to compare the configuration of Asian ECs to that of other ECs—consists of two consecutive steps, inspired by Amable (2000, 2003; 2010*b*) and Balzat and Pyka (2005):

2.4.1 Characterization of ECs' institutional sub-profiles The first step allows us to propose a typology of ECs according to their common characteristics within each institutional domain and to see whether or not Asian countries are relatively homogeneous regarding these six areas. Each institutional domain is treated by principal components analysis (PCA) and mixed clustering techniques. Factorial analysis methods consist of searching for a subspace with few dimensions as the best proxy for the initial scatter of points (multi-dimensional) so as to keep only pertinent information. This compression of data is carried out without much loss of information. Proximities within the factorial space are analysed to understand the links between variables, and the similarities among statistical units. The following classification method aims at grouping together statistical units into a small number of classes according to their similarities in order to establish homogeneous and meaningful clusters of countries with respect to each institutional domain. We carry out a mixed classification procedure. The clustering begins with a hierarchically ascending classification technique (cluster analysis). The partition obtained is then consolidated through some mobile-centred method aimed at increasing inter-cluster variance while minimizing intra-cluster variance.[8] We decided to perform this classification only to the axes retained for the PCA analysis (those with an Eigen value superior to 1 following Kaiser's criterion of factor extraction) as they reflect the key dimensions for ECs for each domain.[9] Only the results of the classifications are presented in this article as they constitute a necessary pre-requisite for the global analysis.

2.4.2 Identification of socio-economic models of technological upgrading The second step of the analysis consists of understanding the diversity of emerging socio-economic models of technological upgrading and of questioning the existence of a distinct Asian form. They are understood as a specific architecture of

[8]Appendix 3 provides quality indicators justifying our choice of partitions.

[9]This criterion leads to the selection of three to six axes, depending on the institutional domain studied, and is satisfactory since it allows us to capture almost 75% (from 73 to 78.8%) of the total variance and of the complete information contained in the database.

complementary institutional domains. This notion of complementarity was introduced into comparative institutional analysis by Aoki (1994, 2001) and is at the root of studies of the diversity of models of capitalism. 'Institutional complementarity is present when the existence or the particular form taken by an institution in one area reinforces the presence, or efficiency of another institution in another area' (Amable, 2003, p. 60). These complementarities reinforce the stability of emerging models of capitalism and thus of technological emergence. To identify them, we have created six nominal variables (for the six institutional domains), representing the type of model in place, in such a way that each EC is now represented by a single vector of six institutional sub-profiles. We then carry out a multiple correspondence analysis (MCA) and a clustering on this new 'qualitative' database (see Table 2). This approach gives us a very clear and easy view of complementarities and avoids the clustering being biased by the relative weight of a small group of variables. The grouping obtained indicates the observed recurrent forms of correlation between the institutional domains' configurations and is necessary to identify prevailing complementarities and, possibly, emerging socio-economic models. To ensure the stability of the obtained typology, and notably its non-dependence on the number of clusters selected in the first step, we implement two complementary methods: a similar two-step procedure with alternative partitions resulting from partial PCAs and a global PCA and clustering on the entire quantitative data set (i.e. on the 80 variables).

We now turn to the presentation of our results.

3. Asian emerging countries' model(s) of technological upgrading in perspective

As Asian ECs stand out as future technological leaders, we now examine whether they have come up with a distinctive, common model which could differentiate them from other ECs. Following the two steps previously described, we observe the diversity of emerging socio-economic models as coherent architectures of complementary institutional domains and of Asian ECs models.

3.1 Sources of institutional homogeneity and heterogeneity between Asian emerging countries

An understanding of emerging socio-economic models of technological upgrading requires an accurate description of each institutional domain. We study them now, with a particular focus on Asian countries, searching for proximities in their institutional organization. We find isomorphism between some institutional domains, but homogeneity between Asian ECs is far from being systematic.

3.1.1 The great influence of the Asian developmental state The central role of Asian states in leading their development is an expected result (Wong, 2004). With our study of institutional sub-systems, we can observe precisely how the State's coordinating role is implemented. Asian EC's industrial systems, financial systems and international insertion appear to be directly structured by government interventionism.

Analysis of industrial systems (cf. Table 1 for detailed characterization) reveals that the singular institutional arrangements adopted in Asian ECs in the form of the 'state-led industrial system' is only found in this region (China, India, Malaysia, Thailand, Indonesia and Vietnam). Since their economic transition is far from being completed, these countries choose direct interventionism in order to emerge. Their economies are dominated by the public sector, with a large share of public firms investing heavily, in order to lead national industrialization. Even so, two Asian ECs have distinct and opposing industrial organization models. Korea, not surprisingly, adopts, with nine other ECs, a highly flexible industrial system, with low levels of regulation. State participation in economic activity is limited to ensuring that product markets work efficiently and that the institutional environment is made attractive to firms. We have called this group 'liberalized economies'. Diametrically opposite, the Philippines is the only Asian EC in the 'informal economy' cluster. Business and political climates are so unattractive for firms that an unofficial economy has developed in parallel.

This Asian organization based on the state is also to be found for international integration (Table 1). Although liberal recommendations, like reduction in trade barriers, are given to developing countries, analysis of world modes of integration shows that ECs have adopted different means of integration and that Asian ECs share common features. Six Asian ECs, and nine others, pursue a 'controlled integration'. They have a lot of trade barriers (tariff and non-tariff), lack infrastructure and, consequently seem to be relatively introverted. However, this last conclusion is erroneous. Control of integration should not be interpreted as a desire for autarchy but as a will to choose the way that integration takes place, in order to maximize learning opportunities. The relative dynamism of Special Economic Zones reveals that investment inflows are at once encouraged and controlled. Studies of the Chinese innovation system confirm this result (Liu, 2009). We can add that the very large size of some countries of this cluster (like BRICs) can explain that some relative indicators (FDI and trade) appear, paradoxically, inferior to the mean for ECs ('hall of mirrors' effect, Leadbeater and Wilsdon, 2007). The two remaining Asian ECs (Korea and Malaysia) are in the 'integrated into the global value chain' cluster. They have managed to technologically upgrade and they furnish the world market with high-tech products. As integration into the global value chain leads to real opportunities for learning and for upgrading (Giuliani *et al.*, 2005; Morrison *et al.*, 2008; Pietrobelli and Rabellotti,

Table 1 Clusters characterization by institutional domain: contributing variables[1]

	Cluster labels	Countries[2]	Variable below the average	Variables above the average
Industry	Informal	ARG BGR BRA MAR MEX **PHL** ROM RUS TUN UKR VEN	LocalCompetition, Logistics, Externalization, ControlCorruption, GFCF, PoliticalStability	UnofficialEconomy, TaxRate
	State-led	**CHN IDN IND MYS THA VNM**	EcoTransition, StartingAbusiness	GFCF
	Liberalized	CHL CZE EST HUN **KOR** POL SVK SVN TUR ZAF	UnofficialEconomy	CorruptionControl, PoliticalStability, EcoTransition, Externalization, S_PriceControl, Logistics, S_GvtEI, LocalCompetition
insertion	Controlled	ARG BRA **CHN IDN IND** MAR MEX **PHL** RUS **THA** TUN TUR VEN **VNM** ZAF	FDIin, Trade, Standards, PortInfrastructure, FDIout	Tariff, DocsToX, SEZ
	CGV	CHL **KOR MYS** POL SVK SVN		PortInfrastructure, CGV
	Deployment	BGR CZE EST HUN ROM UKR	SEZ, Tariff, DocsToX	FDIin, XtoDC
Finance	Constrained	ARG MAR ROM TUR	VentureCapital, ShareholderInfo, BankCompetition	
	Dependant	BGR MEX **PHL** POL RUS UKR VEN	ForeignRestriction, CreditBank, CreditToPrivate, VentureK	InternationalFinancing
	National bank	BRA **CHN IDN IND KOR** SVN **THA** TUN **VNM**	CapitalOpen	BankFinanced
	Attractive	CHL CZE EST HUN SVK		ShareholderInfo, CapitalOpen, ForeignRestriction, BankCompetition
	Complete	**MYS** ZAF		Capitalization, CreditBank, CreditToPrivate, InvestorProtection, LegalRights

Human resources	Rigid	ARG BRA MAR MEX **PHL** ROM TUR VEN ZAF	PayPty, S_Bargain, LinkKL, S_dismiss-Cost, Migration, S_minW	HiringDifficulty
	Informal	**CHN IDN IND KOR MYS THA** TUN UKR **VNM**	ForeignExecutives, RigidityHours, Salaried	S_ILOratif, S_FreeAssoc, VulnerableE, LinkKL; PayPty
	Flexible	BGR CHL CZE EST HUN POL RUS SVK SVN	S_FreeAssoc, VulnerableE, S_ILOratif	S_dismissCost, Salaried, ForeignExecutives, S_Bargain
Education	Burgeoning	ARG BRA **CHN MYS THA** TUN VEN ZAF	PISAscience, EmigrSup, PISAread	Gender, ShareExp3, ScienceGraduate
	Two-speed	**IDN IND** TUR	PreScol, Gender, Schooling, Training	H1Bvisa
	Failing	MAR MEX **VNM**	Gender	EmigrSup, EduSpending
	Private high school	CHL EST **KOR PHL**	ShareExp3	Private3, Scol3, PISAread
	Universal	BGR CZE HUN POL ROM RUS SVK SVN UKR	EduSpending, PupilPerClass, Science-Graduate, Private3, Private1	Vocational, Schooling, PreScol, PISAscience
S&T[3]	Dependent	ARG BGR **IDN** MAR MEX **PHL** POL ROM **THA** VEN **VNM**	RDexp, Collabo, RDpublic, RDpriv, IPP, Articles, Patents	Coauthors
	Self-centred	BRA **CHN IND** RUS TUN TUR UKR	Coauthors, NetUsers	RDpublic, RDexp
	Developed	CHL CZE EST HUN **MYS** SVK SVN ZAF		NetUsers, IPP, Patents, Collabo, Articles, Royalties, RDpriv, Citations, RDexp

Note: (1) Only the *v*ariables that significantly differ from the average at a 2.5% level (one sample *t*-test) are reported in the table. Details can be made available upon request. The variables preceded by an 'S' are qualitative scores: a high value indicates high flexibility. (2) Countries' ISO alpha-3 codes are detailed in Appendix 1. Asian countries are shown in bold. (3) The comparison of means is performed excluding Korea because, as explained above, Korea induces a strong bias in the sample mean.

2009, 2011), these countries could be in a positive spiral of knowledge creation. Another key piece of information can be found from the fact that no Asian ECS have a 'multinational companies' regional deployment platform' model. Asian ECs aim to furnish high value-added products to the global value chain and avoid being strategically used as local factory by multinational companies.

The last institutional domain revealing a national orientation for Asian ECs, relative to other ECs, is finance. The expected distinction between banking systems and financial systems proves not to be a reality for ECs. We observe five different financial systems in ECs (see Table 1). The extreme systems are found on the one hand in countries with a limited access to finance that hinders their development and on the other in countries with access to finance, whatever its origin. Between these two extreme forms of financial market six Asian ECs (China, Indonesia, India, Korea, Thailand and Vietnam), plus three others, have developed an alternative model and adopted a 'national banking system'. Their financial systems are relatively closed to foreign funding but enable firms to access loans from the banking sector. This type of financing even allows risky enterprises through venture capital. The well-known specificity of the Asian financing mode (Aoki, 1991; Lee, 2011) is thus confirmed when compared with ECs. Traditionally financed by large national banks, Asian economies have, since the 1997 crisis, implemented reforms to stimulate stock markets and corporate governance. Banks have diversified their activities and are notably involved in portfolio management. Malaysia complements this bank funding with broad access to capital markets and thus joins South Africa in the 'accomplished financial system'. Because capital markets are attractive (and secure) and present real opportunities, countries in this cluster could be considered 'emerging markets'. The last Asian EC, which has a relatively underdeveloped banking system, is the Philippines. Its 'foreign dependent financial model' compensates for the relative underdevelopment of the banking and finance sectors with foreign funding.

Despite some diversity in the configuration of Asian ECs in these three institutional domains, we observe a regional tendency of governments to directly intervene in the economy. Key features of a developmental state can be recognized (Öniş, 1991; Wong, 2004). Its policy consists of orienting firms' rationale in order first and foremost to promote industrialization. In this way price distortion ('getting the price wrong', Amsden, 1992), public ownership of banks and protection from international competition encourage firms to favour long-term strategies, instead of rent-seeking. This coordinating role of the State is common to almost all the Asiatic region. Only a few Asian ECs do not show this specific organization and are consequently looked upon as exceptions.

3.1.2 Wide availability of a malleable workforce Another key, distinctive feature of Asian ECs is that their human resources and educational systems are organized in order to put a cheap and malleable workforce at firms' disposal. ECs' comparative advantage is often attributed to their inexpensive labour force but this characteristic appears in our study to be particularly relevant to Asian ECs.

The traditional distinction between pro-worker ('rigid human resources systems') and pro-employer labour markets ('flexible human resources systems') is consistent with evidence from ECs but Asian ECs have their own way of managing human resources (details in Table 1). Seven of them (China, Indonesia, India, Korea, Malaysia, Thailand and Vietnam) plus two other ECs (Tunisia and Ukraine) have developed 'informal human resources systems'. Basic labour standards are not attained (weak ratification of ILO conventions, weak enforcement of freedom of association and right to collective bargaining) and workers are really isolated in their employment relationship. In this context, vulnerable employment develops and substitutes for formal labour. This system provides a cheap and malleable workforce. Only one country substantially differs from this typical Asian system of managing human resources: the Philippines, which uses the 'rigid' model characterized by strong market regulations. Consequential substantial emigration observed in these systems can hinder development, notably if it concerns skilled workers, in restricting the accumulation of technological capabilities. This negative brain drain is particularly costly for more technologically backward economies (Di Maria and Stryszowski, 2006).

The provision of a cheap and malleable workforce in Asian ECs is also facilitated by that their population is relatively low-skilled. Six Asian ECs are grouped in the three first clusters of education systems (see Table 1), which have in common a relatively uneducated population with bad performances on basic tests and weak vocational and technical skills. To go beyond a simple characterization of Asian ECs by their relatively undeveloped education systems, we choose to cut the hierarchical tree at a finer level. Three Asian ECs (China, Malaysia and Thailand) reveal a 'burgeoning education system'; distinguished by a real will to improve schooling. Expenditure is significant, and particularly directed to extending the duration of schooling of the population, without gender discrimination. This model also leans on company training schemes to furnish necessary skills. This private and public involvement in skill-creation helps to prevent too great a number of students from emigrating. The lack of basic skills induces different reactions in other models. In Indonesia and India (plus Turkey), very little seems to be done to improve schooling (by either the public or the private sector). This model is above all characterized by the substantial emigration of workers to the USA for specialized occupations. Overall, this model shows that mass education is abandoned in favour of the creation of specialized skills, more valuable abroad. These ECs could be those which manage to convert *brain drain* into

brain circulation (Saxenian, 2006). We describe these education models as 'two-speed'. Vietnam is the only Asian country showing a 'failing education system'. In such systems, public expenditure on education, although very high, cannot compensate for bad quality and lack of schooling in the population and students flee such systems to enrol in high schools abroad.

Two Asian ECs have escaped this low-education meta-group and have oriented their education systems towards production of specialized skills and knowledge. Korea and the Philippines are grouped with Chile and Estonia because of their successful private sector's strong involvement in tertiary education (to compensate for lack of public investment). This model is named 'private high school biased'. We can also observe that no Asian EC has developed a 'universal education system'. This democratic system is only achieved by CEE ECs and provides the whole population with the ability to pursue whatever studies they choose, and especially vocational and technical training.

If the comparative advantage of Asian countries cannot be attributed only to their cheap workforce, it is nevertheless a constitutive dimension of their specificities. Having a relatively unskilled labour force can restrict the acquisition of knowledge and technologies. The heterogeneity of scientific and technological profiles shows that Asian ECs have adopted different ways of compensating for this potential shortcoming.

3.1.3 No single way to create and disseminate knowledge and technologies We identify four types of S&T system in ECs, whose main characteristics are presented in Table 1. As the Korean position, despite preliminary corrections, is very extreme, underlining its relatively 'mature S&T system', we choose to repeat the analysis without this country. This procedure allows us to bring out the subtler points across ECs and to avoid obtaining a blur of countries only differentiated by their backwardness relative to Korea.[10] By doing this, we identify three other models of S&T systems in ECs. Asian countries are divided among the three clusters, revealing the heterogeneity of their S&T systems.

Only one Asian country, Malaysia, appears to have a 'developed S&T system'. All the building blocks of a national innovation system are relatively strong (inputs, outputs, incentives, dissemination). Other countries presenting this developed model are mostly CEE ECs and Malaysia is thus seen as an exception. The other six Asian countries look similar in the sense that they all have inferior S&T outputs. Compared with other ECs, Asian countries have a surprisingly low capacity to create new ideas and products *sensu stricto*. Four of them (Indonesia, the Philippines, Thailand and Vietnam) are grouped in a cluster

[10]Classifications of countries do not change much, except Malaysia and South Africa whose S&T systems, initially characterized as 'self-centred', are from now in the 'developed' cluster.

distinguished by its relative 'dependence' on knowledge creation. These S&T systems accumulate the two weaknesses of an emerging innovation system, i.e. 'a system where only some of its building blocks are in place and where interactions between the elements are still in formation' (Chaminade *et al.*, 2009). Consequently, outputs are very limited and we note that scientific production is non-autonomous but relies on foreign researchers. However, low intellectual property protection can foster their technological upgrading through imitation, as these countries are distant from the world technology frontier (Wu, 2010). Finally, the two Asian BRIC countries are engaged, with five other ECs, in strengthening their S&T system through national efforts of R&D supported by the state. Moreover, the relatively weak scientific collaboration with foreign countries leads us to describe these S&T systems as 'self-centred'. On the whole, we observe heterogeneity in S&T system models between Asian countries. There is no specifically Asian way to create and disseminate knowledge and technology.

This first step of the global analysis suggests the existence of an Asian pattern of technological emergence. To question Asian socio-economic model(s) of technological upgrading, and to search for a coherent clustering, we have to understand the complementarities linking the different building blocks.

3.2 Asian ECs' socio-economic model(s) of technological upgrading

The existence of isomorphism between different institutional domains is not evidence of a system's stability. Complementarities, in the economist's sense, are necessary to link them. '[W]hen they occur together, [different institutions] produce a stable model that is mutually reinforcing' (Crouch, 2010, p. 124). With this second step of the global analysis, we examine socio-economic systems of ECs in their entirety in order to understand the architecture of complementary institutional domains.

Five emerging models of capitalism are identified (Table 2).[11]

[11]Because the optimal number of different classes is not so clear for partial PCAs on education and financial systems (see Appendix 3), we have repeated the analysis with alternative partitions. If we choose to consider four or six clusters for the financial domain, the second step of the global analysis produced exactly the same typology of ECs. Similarly, when choosing a three or four classes' partition for education systems, the only modification of the typology is the grouping of Turkey, which moves from cluster 2 to cluster 1. Our results are thus not reliant on the number of clusters chosen. A PCA and a hierarchical cluster analysis were performed simultaneously on the complete quantitative data set (i.e. on the 80 variables) in order to confirm the robustness of our results. The two methods yield very similar results except that PCA places Korea with South Africa and Malaysia in a common system, and that Brazil and Morocco change respectively from cluster 2 (1) in MCA to cluster 1 (2). The relative stability of the results between these alternative methods attests to the robustness of our typology.

Table 2 Characteristics of emerging socio-economic models of technological upgrading

Cluster	Country	S&T	Industry	Education	Finance	Human resources	International integration
Cocktail	Argentina	Dependent	Informal	Burgeoning	Constrained	Rigid	Controlled
Cocktail	Venezuela	Dependent	Informal	Burgeoning	Dependent	Rigid	Controlled
Cocktail	Morocco	Dependent	Informal	Failing	Constrained	Rigid	Controlled
Cocktail	Mexico	Dependent	Informal	Failing	Dependent	Rigid	Controlled
Cocktail	**Philippines**	Dependent	Informal	Private sup	Dependent	Rigid	Controlled
Cocktail	Romania	Dependent	Informal	Universal	Constrained	Rigid	Deployment
Cocktail	Bulgaria	Dependent	Informal	Universal	Dependent	Flexible	Deployment
Cocktail	Russia	Self-centred	Informal	Universal	Dependent	Flexible	Controlled
Cocktail	Ukraine	Self-centred	Informal	Universal	Dependent	Informal	Deployment
Directed	**Thailand**	Dependent	State-led	Burgeoning	Bank	Informal	Controlled
Directed	**Indonesia**	Dependent	State-led	Two-speed	Bank	Informal	Controlled
Directed	**Vietnam**	Dependent	State-led	Failing	Bank	Informal	Controlled
Directed	Brazil	Self-centred	Informal	Burgeoning	Bank	Rigid	Controlled
Directed	Tunisia	Self-centred	Informal	Burgeoning	Bank	Informal	Controlled
Directed	**China**	Self-centred	State-led	Burgeoning	Bank	Informal	Controlled
Directed	**India**	Self-centred	State-led	Two-speed	Bank	Informal	Controlled
Directed	Turkey	Self-centred	Liberalized	Two-speed	Constrained	Rigid	Controlled
De-centralized	**Korea**	Mature	Liberalized	Private sup	Bank	Informal	GVC
Finance-led	**Malaysia**	Developed	State-led	Burgeoning	Complete	Informal	GVC
Finance-led	South Africa	Developed	Liberalized	Burgeoning	Complete	Rigid	Controlled
Liberalized	Chile	Developed	Liberalized	Private sup	Attractive	Flexible	GVC
Liberalized	Estonia	Developed	Liberalized	Private sup	Attractive	Flexible	Deployment
Liberalized	Poland	Dependent	Liberalized	Universal	Dependent	Flexible	GVC
Liberalized	Slovenia	Developed	Liberalized	Universal	Bank	Flexible	GVC
Liberalized	Czech Rep.	Developed	Liberalized	Universal	Attractive	Flexible	Deployment
Liberalized	Hungary	Developed	Liberalized	Universal	Attractive	Flexible	Deployment
Liberalized	Slovakia	Developed	Liberalized	Universal	Attractive	Flexible	GVC

Note: Clustering in the first column is that obtained after MCA. Asian countries are shown in bold.

Asian ECs mainly belong to the second cluster (Thailand, Indonesia, Vietnam, China and India), which can thus reveal key characteristics of the Asian model of technological emergence. The two very distinctive features previously identified, i.e. the developmental States involvement in the economy and the wide availability of a cheap and malleable workforce, are at the root of a very coherent model of technological upgrading that we characterize as 'directed'. This is based on protected and enhanced self-centred development thanks to the great involvement of the State in providing predictable incentives and a stable institutional environment.

Development of national industries is boosted by the relative introversion found in Asian ECs. This is far from being restrictive to business inasmuch as long-term investment strategies are allowed by a well-developed national bank-based system. Protection from international competition, provided by various barriers to free trade, complements this orientation towards nation-centred development. When describing the 'wild-geese flying' pattern of Asian industrial development, Akamatsu (1962) recognizes the necessity of protective policies (also called economic nationalism) in order to promote the development of new industries. This institutional organization allows the progressive technological upgrading of Asian production, and the consequential high degree of homogenization with developed countries. The coordinating role of Asian states is thus crucial in directing industrialization. Complementarities may also be found with the education and human resources systems. By providing an unskilled, cheap and malleable workforce, the very informal management of resources and under-developed education system foster accelerated development. As far as technological upgrading is concerned, maximization of knowledge and technological spillovers appears to be targeted. The institutional architecture of Asian ECs is not only attractive for national firms but also for multinational companies. Special Economic Zones development shows that the penetration of multinational corporations is not restricted but controlled, indeed encouraged, but only for chosen subsidiaries. This type of insertion could be beneficial for learning if the selection of subsidiaries takes into account the technological level or skills-development of firms. Because R&D maximizes the absorption of knowledge and technological spillovers (Cohen and Levinthal, 1989), the fact that most of the countries of this 'directed model' adopt a self-centred S&T system, characterized by large internal R&D supported by the State, supports the feasibility of such a model for upgrading.

The success in this group of the bigger countries of our panel (China, India and Brazil) reveals another piece of information. Their huge domestic markets increase the feasibility of this self-centred technological development model. Altenburg *et al.* (2008) detail China and India's advantages due to their size and rapid growth. They benefit from a very large scale of accumulation

concerning skills and capital and a high potential for attracting FDI and are thus able to develop bargaining power, as soon as governments are involved in this aspect. By encouraging investors to share knowledge, *they sell a market in exchange for technologies* and their S&T systems thus gain in autonomy (Yusuf and Nabeshima, 2007). The directed socio-economic model of technological upgrading is then based on controlled tapping into the world knowledge reservoir.

Some Asian ECs, already mentioned as exceptions, differ from this typical Asian model of emergence and are grouped with other ECs to form alternative models of upgrading.

Malaysia joins South Africa and adopts 'finance-led capitalism'. They are the only countries with a complete financial system. Firms in these countries have the real choice between calling on bank loans or on initial public offers. Market capitalization is twice as high as Korea's and four times that of the second best socio-economic model. Rather than relying on the wide availability of a cheap, malleable workforce, Malaysia's model is based on financing facilities and on an incentive-oriented institutional environment (intellectual property protection, university-company collaborations) to encourage firms to develop R&D activities, and to upgrade. This strategy of reliance on the construction of emerging markets has been effective in attracting multinational companies and in developing high-tech specialization, notably in electrical and electronic products, but proves to have some limitations in enabling diversification and upgrading. Because of the weak development of the education system and of the absence of national champions, gains in independence are restricted and technologically led development does not occur (Yusuf and Nabeshima, 2009). The Malaysian finance-led model seems to have been hi-jacked by multinational companies.

Korea also appears to have a very specific institutional configuration and cannot be grouped with other ECs given its technological (and economic) development. Its S&T system has all the characteristics of being mature, with, among other things, a dense network of actors who are highly involved and a high number of granted patents. This high efficiency of the S&T system is due to the availability of a highly skilled and malleable workforce. Private involvement in education systems has led to a very high proportion of the population studying well beyond 18. Not surprisingly, Korea has a very high position in the global value chain.

The last exception to the Asian group is the Philippines. It adopts, with eight other non-Asian ECs a 'cocktail model'. These countries have a very contradictory position. Classified as technological ECs, they seem, however, to have applied negative complementarities. The combination of a business climate which offers few incentives and the shortage of possibilities for financing restricts economic activities, resulting in the development of an informal sector. Consistently with this, the national S&T system is embryonic and does not develop independently.

In addition, the rigid management of human resources and barriers to international trade prevent these countries from being a privileged location for multinational corporations and thus benefitting from international knowledge and technological spillovers. This model is not oriented towards accumulation of either external or endogenous learning. The institutional architecture acts in a vicious circle because none of the institutional domains can evolve in a positive way (towards knowledge upgrading) without support from the others. Since it borrows non-complementary institutional forms from different models of capitalism, we have called this model 'cocktail capitalism'. This institutional configuration seems unable to support an upgrading process.

Despite the fact that there are differences between Asian ECs' institutional architectures, there is a common feature which unifies them: no Asian EC presents a flexible, liberalized and freely competitive model. This other very coherent socio-economic model of technological upgrading is only adopted by CEE ECs and Chile. 'Liberalized' countries have a technological and development strategy based on integration into multinational companies' global production. Implementation of liberal precepts, respect of international standards and the building of an institutional environment which is very attractive to FDI indicate their will to construct institutional comparative advantage so as to attract and take advantage of multinational corporations' subsidiaries. These countries rely on integration into multinational corporations' strategies in order to develop and are in this sense 'dependent market economies' (Nölke and Vliegenthart, 2009). Unlike CEE countries, Asian ECs do not have a technological development strategy based on taking advantage of complete integration into world economy. The scale of Asian capitalism is first and foremost national and that explains why national regulations prevail.

On the whole, the eight Asian countries of our panel are dispersed among four of the five different emerging forms of capitalism. The relative dispersion of their institutional profiles does not indicate that an Asian model of emergence does not exist. We now discuss the existence of an Asian path towards emergence, as a trajectory linking the different socio-economic models of Asian ECs.

4. Discussion: is there an Asian path towards technological emergence?

Our analysis corroborates the main findings of monographs or of qualitative approaches to restricted groups of Asian countries and allows them to be put into perspective. These are thus very complementary methods which enrich each other and enlarge knowledge of the emergence process. With 27 ECs under comparison, we reach a level of generality that permits a restriction of the complexity of each real, individual experience and the extraction of the more distinctive and common features between them.

We have particularly emphasized four main features of technological emergence: (i) There is no single model of technological emergence but a diversity of institutional architectures sustaining development through upgrading. (ii) The Asian model of emergence is not an ideal for all ECs. We also observe other very distinct viable and stable socio-economic models, like that of CEE ECs, based on a compliance with liberal precepts. (iii) There is no geographical definition of emergence models. Asian countries are, for example, not the only ones adopting a 'directed model' of emergence. We also find large countries, like Brazil, or Tunisia and Turkey, coordinated by a developmental state. (iv) Although there are some key unifying features between Asian ECs (i.e. economic coordination by a developmental state and the availability of a large, cheap, malleable workforce), we cannot simply conclude that a single archetypal Asian model of emergence exists. We observe a main ideal-typical model, adopted by five Asian ECs, from which some other Asian ECs diverge with altered models. As Rudra (2007) highlights, neither hypotheses of convergence nor of extreme divergence reflect reality. As in other geographical regions, 'systematic divergence' characterizes Asian ECs.

In order to guide our reflexion on why Asian ECs are dispersed among four of the five types of socio-economic model, we now put forward the hypothesis of the existence of an Asian path towards emergence. In that sense, Asian countries could have started their upgrading process at different periods and at varying speeds, thus explaining the observed differences. Based on this eventuality, Asian ECs could be following each other along a single trajectory towards technological emergence. Korea may be the leading goose (after Japan) while other Asian ECs may be following geese (Palma, 2006).

Indeed, Korea's institutional architecture is different from the main 'directed' group because of its relative maturity. Korea developed thanks to a 'developmental state' (Amsden, 1992) or 'dirigist state' (Lee and Yoo, 2007) which provided a predictable and stable environment for national champions: *chaebols*. Since 1980, the Korean state has progressively withdrawn and this explains why market coordination mechanisms have become established (Kang, 2010). As the institutional architecture of Korea leads us to understand, this initial developmental model has now reached a maturation stage (Wong, 2004). We can therefore characterize its socio-economic model as 'de-centralized'. Korea now benefits from clear autonomy for technological creation and is proving to be a leading country for certain technologies, and notably for ICTs, as confirmed by the great success of big Korean conglomerates like LG and Samsung.

This country may thus be considered as an *emerged country* and, as a consequence, comparisons have been made with OECD countries. In these studies, Korea is grouped with Japan to form the Asian capitalism model (Amable, 2003) or the mesocorporatist SSIP (Amable and Petit, 2002). Its key characteristics are

very similar to those found in our study and complement the understanding of Korean capitalism. Large corporations, in collaboration with the State, are key players in this capitalism. Their long-term strategies are supported by a centralized financial system and are accepted by the skilled workforce because they provide *de facto* protection of employment. Because of its intermediate position (Kang, 2010), inclusion of Korea in our panel of ECs allows us to put studies of capitalism in ECs and in developed countries into perspective. It has been following and catching up with OECD countries and can now be considered as a leader of Asian ECs.

Asian ECs belonging to the 'directed' group seem to take Korea as a model. The coordinating role of the State observed in our analysis is very similar to that described in previous studies of Korean capitalism. Thailand, Indonesia, Vietnam, China and India could thus be following Korea in the Asian path towards technological emergence. Thanks to the great support of the State, they are accumulating learning, from internal or external sources, in order to build strong national technological capabilities. The maturation stage does not yet seem to have been reached and coordination by the State may still be necessary before starting to promote market mechanisms.

For Lee and Yoo (2007), this coordinating role of the State has become more and more essential over recent years. Since the knowledge and skills necessary for innovation are locally embedded and increasingly geographically dispersed, the actors involved in this process—the State, academic institutions and industry—need concrete and formal coordination. Relaxation of state central control in Asian ECs may thus be delayed. Other differences in the context between the Korean experience of late development and that in Asian ECs' are underlined by Whittaker et al. (2010). For him, development today may be accelerated and may rely more on specialization in complementary types of production than on homogenising with those already found in advanced countries. This *compressed development* thus cannot simply copy previous effective arrangements.

The case of the Malaysian finance-led model, which might be considered as being intermediate between the Korean de-centralized model and the directed model, confirms the absence of a strict analogy between Asian experiences. Relaxation of control over international integration may have occurred too early and that would explain why Malaysia is caught in a middle income trap (Yusuf and Nabeshima, 2009). Targeted attraction of multinational corporations has prejudiced the autonomy of national technological capabilities, because of the absence of leading domestic firms and of a skilled workforce. In that sense, Malaysia may have failed to follow the Asian method of taking advantage of multinational companies described by Hobday (2003), when studying the stages in the development of the electronics industry in East and South East Asia. For him, initially exploited to benefit from their cheap workforce, Asian countries accumulate learning within multinational corporations subsidiaries so as to be able, in a second

stage, to gain independence in the production process (and notably in product design). This new Asian version of 'wild-geese flying' should end with the creation of a rival, new (protected) Asian brand and give access to the high value-added functions of the global value chain. Malaysia should thus engage in developing an internal and active learning strategy (Viotti, 2002) in order to attain this second stage, and to achieve technological autonomy.

The situation in the Philippines, which could be at the very beginning of the Asian path towards emergence, is more difficult to interpret. The State intervenes in the economy, notably setting barriers to free trade and taxes on products, but does not play a coordinating role. Its restrictive effect on business has negative results, such as encouraging the development of an informal economy. Institutional change is necessary in order to put the Philippines on a sustainable path towards technological upgrading. This could be towards an Asian model, but not necessarily. The complementarities that would be put into place could direct the Philippines towards one of the existing models but could also constitute a new, original form.

To pursue the understanding of the technological upgrading process, it is now necessary to go beyond our comparative description of socio-economic models of ECs in order to propose an analytical approach to emergence (Crouch, 2005). Consideration of trajectories, for example reproducing this analysis at different points in time between the beginning of the 1990s and the recent period, would have shed light on the emergence process. However, scarcity of time series data for such a large panel of ECs prevents this type of analysis. Monographs, even concerning more restricted institutional domains, are again very useful in retracing these trajectories. For more immediate future work, two main directions seem to us to be of interest: Productivity enhancing complementarities could further be studied, following Amable *et al.*'s econometric method and various key determinants of technological upgrading, according to the socio-economic model adopted, could be identified (Amable *et al.*, 2010*a*). This opens up a large area for future research.

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Appendix 1 Emerging countries ISO alpha-3 codes

Code	Country	Code	Country	Code	Country
ARG	Argentina	IND	India	SVK	Slovakia
BGR	Bulgaria	KOR	Korea	SVN	Slovenia
BRA	Brazil	MAR	Morocco	THA	Thailand
CHL	Chile	MEX	Mexico	TUN	Tunisia
CHN	China	MYS	Malaysia	TUR	Turkey
CZE	Czech Republic	PHL	Philippines	KR	Ukraine
EST	Estonia	POL	Poland	VEN	Venezuela
HUN	Hungary	ROM	Romania	VNM	Vietnam
IDN	Indonesia	RUS	Russia	ZAF	South Africa

Appendix 2 Variables and description of sources

Variable name	Description	Database name
Industrial systems—13 variables		
EcoTransition	Indicator of economic transition: contribution to GDP of three sectors (agriculture, industry and services) Σ (share of each sector to GDP in emerging country i $\times$ average share of each sector in high-income OECD country) $= 1.55 \times$ agriculture value-added/GDP $+ 25.86$ - $\times$ industrial VA/GDP $+ 72.59 \times$ services VA/GDP	Author calculation, with data from WDI
GFCF	Gross fixed capital formation (% of GDP)	WDI
UnofficialEconomy	Size of the unofficial economy as a share of GDP	DLLS
Externalization	Density of externalization and outsourcing linkages among domestic firms and between domestic and foreign firms (score from 1 if no linkages to 4 if strong linkages)	Institutional profiles
S_GvtEI	Government enterprises and investment (score from 0 to 10: countries with more government enterprises and government investment received lower ratings)	EFW
S_Transfers	Transfers and subsidies as a percentage of GDP (score from 0 to 10: lower ratings for countries with larger transfer sectors)	EFW
CorruptionControl	Control of corruption (score from -2.5 to 2.5 when no corruption)	WGI

Continued

Appendix 2 Continued

Variable name	Description	Database name
S_PriceControl	Price controls (score from 0 to 10 countries were given a rating of 10 if no price controls or marketing boards were present. When price controls were limited to industries where economies of scale may reduce the effectiveness of competition (e.g. power generation), a country was given a rating of 8. When price controls were applied in only a few other industries, such as agriculture, a country was given a rating of 6. When price controls were levied on energy, agriculture, and many other staple products that are widely purchased by households, a rating of 4 was given. When price controls applied to a significant number of products in both agriculture and manufacturing, the rating was 2. A rating of zero was given when there was widespread use of price controls throughout various sectors of the economy)	EFW
StartingAbusiness	Ease of starting a business (score from 0 to 10: countries where it takes longer or is more costly to start a new business are given lower ratings)	EFW
PoliticalStability	Political Stability and Absence of Violence/Terrorism (score from −2.5 to 2.5 for more stable systems)	WGI
LocalCompetition	Intensity of local competition (score from 1 to 7)	KAM
TaxRate	Total tax rate: amount of taxes and mandatory contributions borne by the business in the second year of operation, expressed as a share of commercial profit	Doing Business
Logistics	Logistic performance index: quality of trade- and transport-related infrastructure (score from 1 to 5)	WDI
International integration—11 variables		
Trade	Trade (% of GDP)	WDI
FDIin	Foreign direct investment, net inflows (% of GDP)	WDI
FDIout	Foreign direct investment, net outflows (% of GDP)	WDI

Continued

Appendix 2 Continued

Variable name	Description	Database name
XtoDC	Merchandize exports to developing economies within region (% of total merchandize exports)	WDI
CGV	Value Chain presence (score of 1 if exporting companies in the country are primarily involved in resource extraction or production, to 7 if they not only produce but also perform product design, marketing, sales, logistics, and after-sales services)	KAM
Tariff	Tariff rate applied, mean for all products (%)	WDI
PortInfrastrcture	Quality of port infrastructure (score of 1 = extremely underdeveloped to 7 = well developed and efficient by international standards)	WDI
DocsToX	Number of documents required to export	WDI
Xtime	Lead time (in days) to export, median case	WDI
Standards	Quality standards (domestic or international) (score of 0 if no norm, and from 1 if low impact of norms to 4 if strong impact of norms on quality)	Institutional profiles
SEZ	Degree of dynamism of special economic zones (score of 0 if no SEZ, and from 1: if few or inefficient SEZ to 4 if they are efficient and numerous)	Institutional profiles
Financial systems—12 variables		
CreditBank	Domestic credit provided by banking sector (% of GDP)	WDI
BankFinanced	Firms using banks to finance investment (% of firms)	WDI
CreditToPrivate	Domestic credit to private sector (% of GDP)	WDI
Capitalization	Market capitalization of listed companies (% of GDP)	WDI
VentureK	Availability of Venture Capital (score from 1 to 7)	KAM
InternationalFinancing	Financing via international capital markets (gross inflows, % of GDP)	WDI

Continued

Appendix 2 Continued

Variable name	Description	Database name
ForeignRestriction	Foreign ownership/investment restrictions (score from 1 if foreign ownership of companies is rare, limited to minority stakes and often prohibited in key sectors and if rules governing foreign direct investment are damaging and discourage foreign direct investment to 7 if foreign ownership is prevalent and encouraged and if rules governing FDI are beneficial and encourage it)	EWF
CapitalOpen	Degree of openness of domestic private firms and of public utilities market to foreign capital (score of 0 if no foreign capital; from 1 if low degree of openness to 4 if no protections)	Institutional profiles
BankCompetition	Foreign bank competition (score from 0 to 10 if a country approves all or most foreign bank applications and if foreign banks have a large share of the banking sector assets)	EWF
InvestorProtection	Strength of investor protection index, i.e. strength of minority shareholder protections against directors' misuse of corporate assets for personal gain (score from 0 to 10)	Doing Business
LegalRights	Strength of legal rights index. Strength of legal rights index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. (score from 0 to 10, with higher scores indicating that these laws are better designed to increase access to credit)	WDI
ShareholderInfo	Information on the shareholder structure of private firms (score from 1 if no information to 4 if high levels of information)	Institutional profiles
Human resources systems—16 variables		
Salaried	Wage-earning and salaried workers in the working population	KILM
VulnerableE	Vulnerable employment, i.e. unpaid family workers and own-account workers, (% of total employment)	WDI
Migration	Net migration (per million people)	WDI

Continued

Appendix 2 Continued

Variable name	Description	Database name
ForeignExecutives	Openness to employment of foreign executives (score of 0 if impossible, if possible, ranking from 1: highly restricted to 4: very easy)	Institutional profiles
Unemploy3	Unemployment with tertiary education (% of total unemployment)	WDI, KAM
lfp_f	Labour force participation of females to labour force participation of males	Callorda Fossati
S_DismissCost	Mandated Cost of worker dismissal (score from 0: the cost measured as weeks of wage is higher than 108 weeks, i.e 1.5 SD above the average to 10: no cost)	EFW
RigidityHours	The rigidity of hours index has 5 components: (i) whether there are restrictions on night work; (ii) whether there are restrictions on weekly holiday work; (iii) whether the working week can consist of 5.5 days or is more than 6 days; (iv) whether the working week can extend to 50 h or more (including overtime) for 2 months a year to respond to a seasonal increase in production and (v) whether the average paid annual leave for a worker with 1 year of tenure, a worker with 5 years and a worker with 10 years is more than 26 working days or fewer than 15 working days (score from 0 to 100 for more rigid systems)	Doing Business
HiringDifficulty	Difficulty of hiring index measures (i) whether fixed-term contracts are prohibited for permanent tasks; (ii) the maximum cumulative duration of fixed-term contracts; and (iii) the ratio of the minimum wage for a trainee or first-time employee to the average value added per worker (score from 0 to 100 for less flexible systems)	Doing Business
PayPty	Link between pay and productivity (score from 1 if pay is not related to worker productivity, to 7 if it is strongly related to worker productivity)	KAM
S_minW	Minimum wage relative to the average value added per worker (score from 0 if minimum wage exceeds 79%—1.5 SD above the average—to 10 if no minimum wage)	EFW

Continued

Appendix 2 Continued

Variable name	Description	Database name
S_ILOratif	Number of ratifications of ILO conventions (with higher weighting for core labour standards) (score from 1 for strong ratification process to 5 for weak ratification process)	Bazillier
LinkKL	Cooperation in labour–employer relations (score from 1 if labour–employer relations are generally confrontational, to 7 if they are generally cooperative)	KAM
S_FreeAssoc	Freedom of Association and Right to Collective Bargaining (score from 1 if very strong enforcement using the ratifications of FARCB, civil liberties index and union density, to 5 if very weak enforcement)	Bazillier
S_Bargain	Centralized collective bargaining (score from 1 if wages are set by a centralized bargaining process to 7 if they are up to each individual company)	EFW
S_lifelong	Practice of guaranteed employment in the private sector (of the 'lifelong employment' type) (score from 1 if it is widely practised, to 4 if it is not practised at all)	Institutional profiles
Education systems—17 variables		
Schooling	Average years of total schooling of the population aged 15 and over	EdStat, Barro et Lee
Scol3	Percentage of population aged 15 and over that has attained tertiary education	EdStat, Barro et Lee
PreScol	Gross enrolment rate (%), pre-primary	EdStat, WDI
PupilPerClass	Pupil/teacher ratio in primary education	EdStat, WDI, UNESCO
Duration	Duration of compulsory education	EdStat
Gender	Gender parity index: female to male gross enrolment ratio in primary and secondary education	EdStat, WDI
PISAscience	PISA: mean performance on the science scale	EdStat
PISAread	PISA: mean performance on the reading scale	Edstat
Vocational	Vocational and technical enrolment (% of total secondary enrolment)	EdStat
ScienceGraduate	Percentage of science graduates (% of the total number of students graduating in all programmes)	UNESCO
EmigrSup	Emigration rate of tertiary educated people (% of total tertiary educated population)	WDI

Continued

Appendix 2 Continued

Variable name	Description	Database name
H1Bvisa	Number of H1B visa (per 100 migrants) The H1B is a non-immigrant visa in the USA which allows US employers to temporarily employ foreign workers in specialized occupations, i.e. occupations requiring theoretical and practical application of a body of highly specialized knowledge in a field of human endeavour including, but not limited to, architecture, engineering, mathematics, physical sciences, social sciences, biotechnology, medicine and health, education, law, accounting, business specialities, theology and the arts, and requiring the attainment of a bachelor's degree or its equivalent as a minimum	Author calculation, based on the Statistical Yearbook of Immigration and Naturalization
EduSpending	Public spending on education, total (% of government spending)	EdStat WDI, UNESCO
ShareExp3	Share of public expenditure for tertiary education (% of total education expenditure)	EdStat
Private1	Private enrolment share (%), primary	EdStat, WDI
Private3	Private enrolment share (%), tertiary	EdStat
Training	Firms offering formal training (% of firms)	WDI
Scientific and technological systems—11 variables		
Articles	Scientific and technical journal articles (per million people)	WDI, KAM
Citations	Average number of citations per scientific and engineering article	KAM
Patents	Patents granted by USPTO (per million people)	KAM
Royalties	Receipts from royalties and licences ($, per million people)	WDI, KAM
RDexp	Research and development expenditure (% of GDP)	WDI, KAM
RDpriv	Private sector spending on R&D (score from 1: do not spend, to 7: spend heavily relative to international peers)	KAM
RDpublic	Public support for R&D activities (score of 0 if no policy, from 1 (inefficient policy) to 4 (very efficient policy)	Institutional profiles
Coauthors	Scientific and engineering articles with foreign co-authorship (%)	KAM
Collabo	University-Company Research Collaboration (score from 1: minimal or non-existent to 7: intensive and on-going)	KAM

Continued

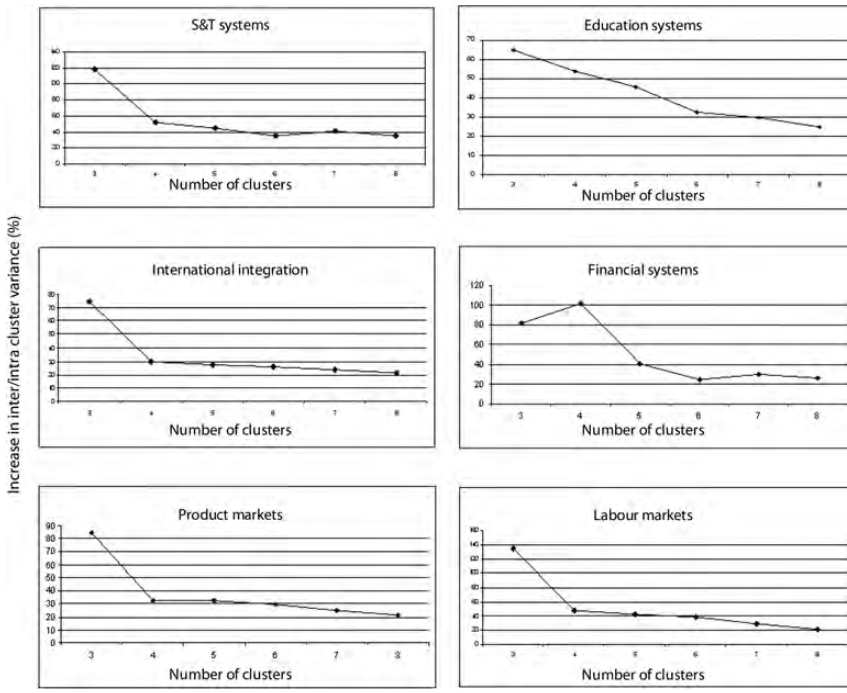
Appendix 2 Continued

Variable name	Description	Database name
IPP	Intellectual Property Protection (score from 1: weak or non-existent to 7: is equal to the world's most stringent)	KAM
Net users	Internet users (per 100 people)	EdStat, WDI, KAM

Note: The variables preceded by an 'S' are qualitative scores: a high value indicates high flexibility.

Database name	Source
Barro et Lee	Barro and Lee (2010)
Bazillier	Bazillier (2008)
Callorda Fossati	Callorda Fossati (2011)
DLLS	Djankov *et al.* (2002)
Doing business	World Bank
EdStat: Education Statistics	World Bank
EFW: Economic Freedom of the World	Frazer Institute
KAM: Knowledge assessment methodology	World Bank
KILM: Key Indicators of Labour Markets	ILO: International Labour Organization
Institutional profils	CEPII: Centre d'études prospectives et d'informations internationales
Statistical Yearbook of the Immigration and Naturalization Service	US Department of Justice
UNESCO statistics	UNESCO: United Nations Educational, Scientific and Cultural Organization
WDI: World development indicators	World Bank
WGI: Worldwide Governance Indicators	World Bank

Appendix 3 Selection of the optimal number of different classes



Note: Inter-cluster variance increases while intra-cluster variance decreases with the rise in the number of clusters. The inter–intra-cluster variance ratio thus increases with the number of clusters selected. We are searching for the elbow in the increasing rate of this coefficient. This means that adding a new group, i.e. cutting the hierarchical tree at a finer level, brings a smaller increase in the quality ratio than for the preceding class.

This selection criterion leads us to select three classes for the S&T system, international integration, product and labour markets. The break point is not so clear cut for the two other systems. We choose to retain five clusters for our main analysis, as the decreasing slope marks a slowing down at this level, and to use alternative partitions in order to check robustness.