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Language variation among business abstracts

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Abstract: The old credo of business is to always put the needs and well-being of the customer first. But what the credo fails to mention is that business writing to an international audience and global consumer market today needs largely be done in one language – English. This project aims to examine linguistic variation among business abstracts according to the authors' countries of origin and first languages. The significance of these studies regards the growing number of second-language (L2) business managers and researchers attempting to publish and disseminate their research and business innovations to English-language journals, foreign markets and colleagues, but who find themselves locked out of the discussion due to unfamiliarity with the linguistic and discourse conventions. Through the use of the natural language processing tool, CohMetrix, the present examination aims to provide a more thorough and quantitative understanding of the prototypical linguistic components in business writing, and to suggest how word-, sentence-, and discourse-level structures can be isolated, taught, and developed as educational materials.

Keywords: ESP; English for specific purposes; international business; computational linguistics.

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1 Introduction

Writers with expert knowledge of their specialised fields may be unable to publish their research without certain linguistic and discursive features to guide the reader (Graesser, 1994). Perhaps, this phenomenon explains why an ever-increasing number of highly experienced, second-language (L2) specialised researchers struggle to see their work

published and accepted into the international English-writing community (Flowerdew, 1999a; Flowerdew, 1999b; McCarthy et al., 2007). Currently, little research has sought to quantitatively analyse the prototypical linguistic and rhetorical structures of English business abstracts, less so L2 business abstracts, and fewer still the linguistic and rhetorical elements of L2 business abstracts in relation to first-language (L1) business abstracts. Therefore, this study is unique and significant in its provision to fill the gap in the analysis and perception of English business abstracts among L2 learners. Moreover, the selection of Thai authors as the target group responds to Johns and Swales (2006) petition for a 'multidirectional' (i.e. less Euro-centric) analysis of scientific discourse analysis and for greater examination of the use of English for Specific Purposes (ESP) in general.

While past studies have documented first-person accounts of the struggles experienced by L2 writers in becoming published authors (Swales, 1990; Connor, 1999; Flowerdew, 2000; Li, 1999), these studies have tended to focus on those writers with previously established close ties to the central discourse community, namely students or researchers living and working in US academic and English as a Second Language (ESL) settings as opposed to the vast majority of L2 business researchers who live and work in remote (outside Europe and North America), English as a Foreign Language (EFL) settings; McCarthy et al. (2007) provides a notable exception. Meanwhile the trend towards international publication in English among the business community continues. Lillis and Curry (2006) claim between 74% and 90% of all business research is now being published in English.

There is a need for a more current analysis of the rhetorical and linguistic elements that comprise business abstracts, and which particular linguistic and rhetorical elements may differ across languages. Although considerable literature exists concerning academic writing skills for L2 learners (e.g. Allison et al., 1998) and manuals explicate the rhetorical organisation and linguistic elements most common to the writing of research papers (Swales and Feak, 2000; Swales and Feak, 2004; Weissberg and Buker, 1990), little, if any, attention has been paid to L2's interpretations, demonstrated knowledge and application of specialised research conventions.

This study aims to shed light on differences in the rhetorical organisation and linguistic expression between L1 and L2 writers of English in the international business community. In so doing, this study hopes to provide what Lather (1991) refers to as *catalytic validity*, a term applied to research that develops understanding in those it studies and encourages them to reassess the way they view the world.

2 Methods

2.1 Coh-Metrix

Computational linguistics has been at the forefront of determining how grammatical and lexical features can be used to differentiate one community's shared discourse and shared texts from another's (Biber, 1988). Biber's initial processing of linguistic variation was able to uncover nine linguistic features that could accurately predict whether a text was written or spoken. By combining traditional and new linguistic metrics across word, sentence, and discourse ranges, researchers have been able to uncover the grammatical

and lexical features that separate one genre, or one specialised discourse community, from another. For instance, McCarthy et al. (2006) used Coh-Metrix (Graesser et al., 2004) to distinguish between science, social studies, and narrative texts. McCarthy et al. (2007) used the Coh-Metrix tool to differentiate among American, British, and Japanese scientific abstracts.

Coh-Metrix integrates Biber's (1988) linguistic features, as well as indices of cohesion (Jurafsky and Martin, 2000), readability (Klare, 1974–1975), syntactic parsers (Sekine and Grishman, 1995), part of speech taggers (Brill, 1992), Latent Semantic Analysis (LSA) (Landauer, 2007), word and conceptual indices derived from the WordNet lexical database (Miller, 1990), and the MRC database (Coltheart, 1981), to produce over 650 metrics of language and text.

2.2 *Linguistic and rhetorical variables to be analysed*

A brief summary of the linguistic and rhetorical measures used in this study are included below. For further explanation of these metrics, please see: <http://cohmetrix.memphis.edu/cohmetrixpr/index.html>.

The incidence of part of speech categories: Coh-Metrix has the ability to measure a wide range of incidences of various parts of speech. All of the following parts of speech categories' incidence scores adopted in this study are calculated per 1000 words and categories derive from the Penn Treebank (Marcus et al., 1993) and the Brill (1995) parts of speech tagger. These two banks categorise each word according to content words (e.g. *nouns, verbs, adjectives, adverbs*) or function words (e.g. *prepositions, determiners, pronouns*). Coh-Metrix also provides incidence scores for noun phrases, verb phrases, and prepositional phrases in a text. These tagged categories are extracted from syntactic parse trees generated by the Charniak parser. Incidence differences between various parts of speech for native and Non-Native English (NNS) speakers can be used to isolate the most significant linguistic features of the biomedical abstract and is directly and easily applicable to the classroom. For example, if it is found that native speakers use more gerunds or more cardinal numbers than NNSs, ESP teachers can encourage their non-native students to invoke more of these particular parts of speech. Conversely, if it is found that native speakers use fewer gerunds or fewer cardinal numbers than NNSs, ESP teachers can instruct their non-native students to limit the usage of these particular parts of speech.

The incidence of parts of speech for locational items: Locational items indicate space within a text. Words such as *here, there, over, and under* are considered to be locational items. Locational items may be used to organise relations between ideas and sentences within a text. Such an organisational strategy may make the text easier for the reader to comprehend.

The incidence of parts of speech for temporal cues: Temporal cues indicate the cohesion of time in a text. Temporal cohesion can be calculated by analysing the tense and aspect of particular verbs. Tense refers to the absolute time of an action or event and is marked by the verb inflection (e.g. *Mary cooks* potatoes (present tense); *Mary cooked* potatoes (past tense)). Aspect refers to how an action or event is viewed with respect to time (e.g. *Mary cooked* potatoes (simple past tense = action was completed in the past); *Mary has cooked* potatoes (perfective aspect = action took place at an unspecified time in the past); *Mary is cooking* potatoes (progressive aspect = action is still in progress)).

Coh-Metrix tracks the consistency of tense and aspect across the text. The repetition scores decrease as shifts in tense and aspect are encountered. A low value indicates that the tense and aspect in the text appear disjointed. Duran et al. (2006) show that the local and global indices Coh-Metrix use to calculate temporal coherence accurately predicts a reader's comprehension of the text. Along these lines, more experienced writers repeat tense and aspect as a means of creating greater cohesion in their writing, and NNSs may be unaware of this important technique to enhance coherence and reader comprehension.

The incidence of parts of speech for third-person singular: The third-person singular morpheme (the *-s* on *jumps* as in 'she jumps') indicates present tense usage for third person subjects (he, she, it, common or proper nouns (e.g. *this method* or *Steve Olsen*)). Calculating the incidence of third-person singular morphemes is a convenient way of determining which verb tenses and aspects are most prevalent in the genre. For example, it may be discovered that most Native English Speakers' (NESs) biomedical abstracts are written in the third-person singular tense, while NNSs are using first-person past tense. This discrepancy can easily be pointed out and corrected.

The incidence of parts of speech for cardinal numbers: Cardinal numbers are defined as a number or symbol analogous to the number of elements in a finite set, such as 0.001, 3, or 9/40. The reporting of results in the form of cardinal numbers is an important aspect of the biomedical abstract. By observing the average rate of incidence for cardinal numbers, non-native writers could better formulate their results within their abstracts according to genre conventions.

The incidence of parts of speech for gerunds: A gerund is a verb acting as a noun and ending in *-ing*. For example, the noun *swimming* in *Swimming is good exercise*. Gerunds may be an 'advanced' grammatical structure that NNSs of English may be wary to use in their research. This wariness is simple enough to understand on a basic biological level. When faced with an external threat, animals make a conscience decision of *fight* or *flight*. When confronted with an enemy as imposing as English grammar, *flight* too often is the choice. Kleinmann (1977) relates that second-language learners tend to avoid grammatical structures that differ from their mother tongues. Avoidance of certain grammatical structures is often imperceptible because there is usually an alternative structure to express the target language. For example, the conjugation of first-person future tense verbs in Spanish causes me difficulty; therefore, when forced to use future tense, I may simply say, '*Voy a + verb ...*', which translates to 'I'm going to ...'. A native Spanish speaker would likely have no difficulty understanding my formulation and would probably never realise I was avoiding a grammatical structure that contrasts significantly with my mother tongue (in English we just put *will*, *shall*, or *going to* before the verb to make it future tense). NNSs may likewise avoid certain English grammatical structures in preference of more familiar and more simplistic structures. While such avoidance may temporarily alleviate a NNS' linguistic psyche, the use of 'advanced' grammatical structures likely adds to greater syntactic diversity within a text, thus making authors appear smarter or at least more expressive. In the long run, avoidance of perceived-to-be-difficult grammatical structures may impede NNSs' chances for acceptance and publication.

The incidence of parts of speech for the infinitive -to: An infinitive is the root form of the verb, starting with *to*. It can often be used to separate two verbs, for example I like *to read*). Infinitives are prevalent in Western languages, but not in Eastern languages. As such, NNSs may likely avoid using *-to* infinitives to the extent that NESs use them.

Kleinmann (1977) showed how Spanish speakers avoid *-to infinitives* following the verb *ask*, instead more providing an English equivalent of their mother tongue. Rather than say, 'He asked me to close the window', as a NES would report, the Spanish speakers in Kleinmann's classroom would say, 'He suggested that I should close the window'. Kleinmann's research offers quantitative support for why NNSs may have difficulty incorporating certain grammatical structures into their writing.

The incidence of parts of speech for Wh-adverbs: *Wh*-adverbs involve the use of *who*, *what*, *when*, *where* and *why* as modifiers of verbs, adjectives or other adverbs. For example, the *why* of: *the results indicate why there may be a predilection towards one group*. *Wh*-adverbs may be another 'advanced' grammatical structure that NNS of English may be wary to use in their research, but can add to the syntactic diversity of the writing.

2.3 *The corpus*

The corpus for the present study was compiled for the purposes of comparing three groups: L1 authors whose work has been published in top-tier American business journals in their native English language (AE); L2 Thai authors whose work has been published in top-tier American business journals in English, their second language (AT); and L2 Thai authors whose work has been published in top-tier Thai business journals in English, their second language (TT). The corpus includes AE business abstracts ($n = 500$), AT business abstracts ($n = 500$), and TT business abstracts ($n = 500$). Several selection constraints were applied to ensure uniformity and representation across individual journals and authors. All of the abstracts included in the corpus have been written by medical professors and/or doctors with previous publishing experience and affiliations with medical departments at hospitals or universities. According to previous findings of significant linguistic variation between British and American authors (Hall et al., 2006; McCarthy et al., 2007), the corpus was limited to publications in either American or Thai journals (British, Canadian, Australian, and South African journals were excluded as a result of these previous findings of variations among Englishes), and authorship was limited to only those researchers with common American or Thai names and only American or Thai university or hospital affiliations, respectively. Although the division of the corpus into nationalities based only on names and affiliations is not perfect, the large number of abstracts collected means that irregularities in the division (e.g. Dr. Nattapong Praphasirirat was born in the USA, but is currently working in a Thai university; or Dr. Paul Smith at Harvard Medical College is in fact an Arab immigrant) are unlikely to be a significant confound. Furthermore, a primary objective of this study aims to fill the gap in the linguistic analysis of authors working in foreign, remote areas outside of the Euro-centric community and to compare their writing to that of more centrally established authors within the Euro-centric community. Therefore, differentiation by names and affiliations seems particularly apt.

The corpus was selected in line with Anne Lindeberg and Susan Conrad's hypothesis that top-tier journals involve a more laborious vetting process (80% of submitted manuscripts are rejected), so that what is published reflects 'prototypical exemplars of the genre' (Swales, 1990). In addition, all textual coding other than alphanumeric characters and punctuation (paragraph breaks, captions, headings, figures, and double spaces) was removed. Because matters of presentation (font size, column width, quality

of graphics, typesetting) are most often matters of editors' rather than authors' choice, they were not considered in the data. Text size was not considered to be a precluding factor since Coh-Metrix normalises its findings based on text length. The corpus was cleaned prior to Coh-Metrix analysis. For every abstract, headers, including authors' names, titles, journal names, and dates of publication, were removed. Likewise, endings, including publishers' addresses, author affiliation, and government grant numbers, were removed. Paragraph endings and extra spaces were also removed. Subheadings (background, methods, results) were not included. The focus of the analysis, therefore, was only on the language of the actual abstract.

2.4 Statistical analysis

The corpus was processed by Coh-Metrix. Values for the predicted linguistic and rhetorical elements among the 700+ variables were isolated. Statistical descriptives: M , SD , F , p , and η_p^2 values were calculated for each linguistic variable using SPSS software (SPSS Inc., 2001). Means (M) are a calculation of the sum of the observations divided by the number of observations; in this case, the total number of incidences of a particular linguistic element within a group of abstracts divided the total number of abstracts. Standard deviation (SD) is a measure of how the values are dispersed throughout the set. SD is defined as the root-mean-square deviation of the values from their mean, or as the square root of the variance. F , or effect size, is a measure of the strength of the relationship between variables (in this case the three groups of abstracts). The p -value is a calculation of the statistical significance of the findings and determines the possibility that chance might be responsible for the finding. The smaller the p -value, the more significant (or less likely to be a result of mere chance) the result is said to be. Generally, p -values less than 0.05 are said to be statistically significant, or not likely to be a result of chance. The η_p^2 , or partial Eta squared values, calculates the proportion of the effect plus error variance that is attributable to the effect.

The linguistic and rhetorical components among the three groups were compared using a planned contrast Bonferroni analysis for significant difference. Because all predictions were made *a priori* to the implementation of the study, and because the items to predictors ratio was high (20:1), alpha was set at 0.05. The confidence levels are in line with Cronbach's α , otherwise known as the coefficient of internal consistency, which estimates the results' reliability despite different means and statistical differentiations among variables.

2.5 Predicted hierarchy

Thai speakers who have published in American business journals are expected to more successfully demonstrate coherence to the conventional use of linguistic and discourse elements. In contrast, Thai researchers who have not published in American journals are expected to deviate from the expected linguistic and discourse conventions of the business abstract genre. Thus, we predict that the linguistic and rhetorical elements of AE abstracts will appear more similar to those of AT abstracts (published in American journals) than to those of TT abstracts (published in Thai journals).

3 Results

We processed the corpus using Coh-Metrix. Values for the predicted linguistic and rhetorical elements among the 650+ variables were isolated. Statistical descriptive indices (i.e. M , SD , F , p , and η_p^2 values) were calculated for each linguistic variable using SPSS software (SPSS Inc., 2001). F , or effect size, is a measure of the strength of the relationship between variables. The η_p^2 , or partial Eta squared values, calculates the proportion of the effect plus error variance that is attributable to the effect. The linguistic and rhetorical components among the three groups were compared using a planned contrast Bonferroni analysis for significant differences. The most significant results are presented below.

Word frequency: The results show that AE abstracts contain more low frequency words than AT and TT abstracts. The results suggest that AE abstracts ($M = 1.451$, $SD = 0.235$) contain more low frequency words than their AT counterparts ($M = 1.241$, $SD = 0.236$) and to a somewhat lesser extent than their TT counterparts ($M = 1.366$, $SD = 0.236$) (see Table 1). The average CELEX content word frequency in each sentence was calculated, indicating that American authors are significantly more likely than Thai authors to use more low frequency words ($F [2, 1500] = 100.913$, $p < 0.001$), likely in the form of technical terminology. This result suggests that American authors may be especially adept at employing cohesive strategies through their choice of lexicon, whereas Thai authors may devote more space to grammatically prescriptive, but less lexically cohesive, sentences. The TT group's greater use of low frequency words in comparison the AT group may indicate these Thais still struggle with non-standard grammar and vocabulary. As a whole, NESs use a wider and more advanced range of English vocabulary than Thais do. This factor was found to be the second greatest differentiator among the three groups after total number of words; therefore, it is suggested that the importance of technical words within the business field be stressed to Thai business authors.

Table 1 Descriptive statistics including mean (M) and standard deviation (SD), F , and η_p^2 values for three groups: American business abstracts published in American journals (AE), Thai abstracts published in American journals (AT), and Thai abstracts published in Thai journals (TT)

<i>Dependent variable</i>	<i>M and (SD)</i>			<i>F</i>	η_p^2
	<i>AT</i>	<i>TT</i>	<i>AE</i>		
Number of words per abstract	210.328 (68.257)	199.970 (75.390)	258.704 (64.799)	101.442**	0.119
CELEX content word per sentences	1.241 (0.236)	1.366 (0.236)	1.451 (0.235)	100.913**	0.119
Intentional events/1000 words	13.005 (9.525)	13.709 (9.965)	7.951 (5.923)	65.755**	0.081
Higher-level constituents per word	0.626 (0.038)	0.628 (0.038)	0.650 (0.039)	58.842**	0.073

Table 1 Descriptive statistics including mean (*M*) and standard deviation (*SD*), *F*, and η_p^2 values for three groups: American business abstracts published in American journals (*AE*), Thai abstracts published in American journals (*AT*), and Thai abstracts published in Thai journals (*TT*) (continued)

<i>Dependent variable</i>	<i>M and (SD)</i>				
	<i>AT</i>	<i>TT</i>	<i>AE</i>	<i>F</i>	η_p^2
Hypernym values of nouns	4.080 (0.654)	4.421 (0.612)	4.404 (0.503)	52.614**	0.066
Cardinal numbers/1000 words	48.375 (36.904)	48.666 (45.388)	67.528 (40.477)	35.757**	0.046
Locational prepositions/1000 words	47.281 (18.824)	38.227 (17.213)	42.286 (16.070)	34.042**	0.043
Stem overlap adjacent sentences	0.794 (0.200)	0.706 (0.246)	0.790 (0.201)	26.241**	0.034
Tense aspect repetition score	0.737 (0.277)	0.713 (0.247)	0.806 (0.185)	20.016**	0.026
Argument overlap adjacent sentences	0.738 (0.218)	0.662 (0.253)	0.742 (0.213)	19.283**	0.025
Tense repetition score	0.768 (0.261)	0.762 (0.218)	0.836 (0.159)	17.818**	0.023
Noun overlap adjacent sentences	0.703 (0.224)	0.623 (0.260)	0.698 (0.226)	17.771**	0.023
Concreteness for content words	389.482 (29.161)	385.064 (28.133)	379.389 (23.926)	17.385**	0.023
–to infinitives/1000 words	11.261 (9.085)	9.681 (8.877)	13.238 (10.756)	17.199**	0.022
Words before main clause verb	6.578 (2.963)	5.936 (2.625)	6.812 (3.384)	11.391**	0.015
Third-person singular/1000 words	9.357 (9.630)	10.591 (10.440)	7.730 (9.261)	10.742**	0.014
% Stem overlap adjacent sentences	0.201 (0.076)	0.178 (0.086)	0.195 (0.080)	10.066**	0.013
Locational prepositions and nouns	0.460 (0.114)	0.433 (0.133)	0.435 (0.103)	8.295**	0.011
% Argument overlap adjacent sentences	0.206 (0.092)	0.185 (0.096)	0.204 (0.090)	7.930**	0.010
% Content word overlap adjacent sentences	0.164 (0.069)	0.148 (0.075)	0.160 (0.073)	6.438*	0.009

Table 1 Descriptive statistics including mean (*M*) and standard deviation (*SD*), *F*, and η_p^2 values for three groups: American business abstracts published in American journals (*AE*), Thai abstracts published in American journals (*AT*), and Thai abstracts published in Thai journals (*TT*) (continued)

<i>Dependent variable</i>	<i>M and (SD)</i>			<i>F</i>	η_p^2
	<i>AT</i>	<i>TT</i>	<i>AE</i>		
SD word fam. content words	47.132 (11.842)	47.291 (13.943)	44.987 (10.370)	5.624*	0.007
LD MTL D measure	71.707 (22.316)	76.533 (27.344)	74.302 (20.530)	5.266*	0.007
% Noun overlap adjacent sentences	0.188 (0.088)	0.171 (0.094)	0.185 (0.088)	4.873*	0.006
Wh-adverbs/1000 words	0.935 (2.668)	0.669 (2.038)	1.202 (3.276)	4.860*	0.006
Gerunds/1000 words	13.133 (10.024)	11.926 (9.712)	12.890 (10.046)	2.073	0.003
Concreteness for every word	293.394 (17.110)	293.958 (15.787)	294.429 (13.979)	0.547	0.001
Locational noun/1000 noun phrases	160.482 (68.845)	158.064 (78.304)	162.127 (63.710)	0.420	0.001

Notes: * = statistically significant; ** = very statistically significant.

Syntactic diversity: *AE* abstracts use significantly more diverse syntactic sentence structures than *AT* and *TT* abstracts. *AEs* use more higher-level constituents per word ($M = 0.650$, $SD = 0.039$) than their *AT* ($M = 0.626$, $SD = 0.038$) and their *TT* counterparts ($M = 0.628$, $SD = 0.038$) ($F [2, 1500] = 58.842$, $p < 0.001$). In addition, *AE* abstracts use more words before the main verb of the main clause in their sentences: *AE* ($M = 6.812$, $SD = 3.384$) in comparison to *AT* ($M = 6.578$, $SD = 2.963$) and *TT* ($M = 5.936$, $SD = 2.625$), although this result was only significantly different when comparing the *TT* group ($F [2, 1500] = 11.391$, $p < 0.001$) (see Tables 1 and 2).

Table 2 A planned contrast Bonferroni analysis among the three groups: American abstracts published in American journals (*AE*), Thai abstracts published in American journals (*AT*), and Thai abstracts published in Thai journals (*TT*)

<i>Dependent variable</i>	<i>Higher group (Means)</i>	<i>Smaller group (Means)</i>	<i>P</i>
Number of words per abstract	<i>AE</i> (258.704)	<i>AT</i> (210.328)	< 0.001
	<i>AE</i> (258.704)	<i>TT</i> (199.970)	< 0.001
CELEX content word per sentences	<i>TT</i> (1.366)	<i>AT</i> (1.241)	< 0.001
	<i>AE</i> (1.451)	<i>AT</i> (1.241)	< 0.001
	<i>AE</i> (1.451)	<i>TT</i> (1.366)	< 0.001
Intentional events/1000 words	<i>AT</i> (13.005)	<i>AE</i> (7.951)	< 0.001
	<i>TT</i> (13.709)	<i>AE</i> (7.951)	< 0.001

Table 2 A planned contrast Bonferroni analysis among the three groups: American abstracts published in American journals (AE), Thai abstracts published in American journals (AT), and Thai abstracts published in Thai journals (TT) (continued)

<i>Dependent variable</i>	<i>Higher group (Means)</i>	<i>Smaller group (Means)</i>	<i>P</i>
Higher-level constituents per word	AE (0.650)	AT (0.626)	< 0.001
	TT (0.628)	AT (0.626)	< 0.001
Hypernym values of nouns	AE (0.650)	TT (0.628)	< 0.001
	TT (4.421)	AT (4.080)	< 0.001
Cardinal numbers/1000 words	AE (4.404)	AT (4.080)	< 0.001
	AE (67.528)	AT (48.375)	< 0.001
Locational prepositions/1000 words	AE (67.528)	TT (48.666)	< 0.001
	AT (47.281)	TT (38.227)	< 0.001
Stem overlap adjacent sentences	AT (47.281)	AE (42.286)	< 0.001
	AT (0.794)	TT (0.706)	< 0.001
Tense aspect repetition score	AE (0.790)	TT (0.706)	< 0.001
	AE (0.806)	AT (0.737)	< 0.001
Argument overlap adjacent sentences	AE (0.806)	TT (0.713)	< 0.001
	AT (0.738)	TT (0.662)	< 0.001
Tense repetition score	AE (0.742)	TT (0.662)	< 0.001
	AE (0.836)	AT (0.768)	< 0.001
Noun overlap adjacent sentences	AE (0.836)	TT (0.762)	< 0.001
	AT (0.703)	TT (0.623)	< 0.001
Concreteness for content words	AE (0.698)	TT (0.623)	< 0.001
	AT (389.482)	AE (379.389)	< 0.001
<i>-to</i> infinitives/1000 words	AE (13.238)	TT (9.681)	< 0.001
Words before main clause verb	AE (6.812)	TT (5.936)	< 0.001
Third-person singular/1000 words	TT (10.591)	AE (7.730)	< 0.001
% Stem overlap in adjacent sentences	AT (0.201)	TT (0.178)	< 0.001
Locational prepositions/1000 words	AE (42.286)	TT (38.227)	0.001
Locational prepositions and nouns	AT (0.460)	TT(0.433)	0.001
% Argument overlap adjacent sentences	AT (0.206)	TT (0.185)	0.001
Words before main clause verb	AT (6.578)	TT (5.936)	0.002
Locational prepositions and nouns	AT (0.460)	AE (0.435)	0.002
% Content word overlap adjacent sentences	AT (0.164)	TT (0.148)	0.002
Concreteness for content words	TT (385.064)	AE (379.389)	0.003
<i>-to</i> infinitives/1000 words	AE (13.238)	AT (11.261)	0.003
% Argument overlap adjacent sentences	AE (0.204)	TT (0.185)	0.003
LD MTLT measure	TT (76.533)	AT (71.707)	0.004
% Stem overlap adjacent sentences	AE (0.195)	TT (0.178)	0.005
Wh-adverbs/1000 words	AE(1.202)	TT(0.669)	0.006

Table 2 A planned contrast Bonferroni analysis among the three groups: American abstracts published in American journals (AE), Thai abstracts published in American journals (AT), and Thai abstracts published in Thai journals (TT) (continued)

<i>Dependent variable</i>	<i>Higher group (Means)</i>	<i>Smaller group (Means)</i>	<i>P</i>
SD word fam. content words	TT (47.291)	AE (44.987)	0.008
% Noun overlap adjacent sentences	AT (0.188)	TT (0.171)	0.012
SD word fam. content words	AT (47.132)	AE (44.987)	0.016
Third-person singular/1000 words	AT (9.357)	AE (7.730)	0.026
% Content word overlap adjacent sentences	AE (0.160)	TT (0.148)	0.026
–to infinitives/1000 words	AT (11.261)	TT (9.681)	0.028
Concreteness for content words	AT (389.482)	TT (385.064)	0.030
% Noun overlap adjacent sentences	AE (0.185)	TT (0.171)	0.040
Number of words per abstract	AT (210.328)	TT (199.970)	0.056

These findings suggest that Thai authors gaining publication in American journals may be making use of some syntactical diversity strategies employed by NESs (such as an increased number of words before the main verb) while overlooking other strategies (e.g. higher-level constituents). Thai authors published outside of the central business community, on the other hand, may be largely unaware of the important use of syntactic diversity in NES' writing. Moreover, Thais may be less willing to take risks in their grammatical constructions, and, as a result, use a narrower range of sentence types, which may result negatively in the evaluation of their writing by NESs.

Word concreteness: All three groups displayed a high mean value of word concreteness for content words: AE ($M = 379.389$, $SD = 23.926$), AT ($M = 389.482$, $SD = 29.161$), TT ($M = 385.064$, $SD = 28.133$); and for every word: AE ($M = 294.429$, $SD = 13.979$), AT ($M = 293.394$, $SD = 17.110$), TT ($M = 293.958$, $SD = 15.787$) (see Tables 1 and 2). Likewise, the hypernym values of nouns – AT ($M = 4.08$, $SD = 0.654$), TT ($M = 4.421$, $SD = 0.612$), AE ($M = 4.404$, $SD = 0.503$) – were relatively high for all three groups. This finding verifies that the business genre relies heavily on concrete word usage, stressing the importance of highly imageable words in comparison to abstractions or theories within the community. However, comparisons between all three groups – AT versus TT ($F [2, 1500] = 17.385$, $p = 0.030$), AT versus AE ($F [2, 1500] = 17.385$, $p < 0.001$), AE versus TT ($F [2, 1500] = 17.385$, $p = 0.003$) – show significant differences in the concreteness of content words. Moreover, a comparison of the mean hypernym value of nouns – AT versus TT ($F [2, 1500] = 52.614$, $p < 0.001$), AE versus AT ($F [2, 1500] = 52.614$, $p < 0.001$) – indicates significant difference between two of the three groups. In fact, the mean hypernym value of nouns ranked as the fifth highest factor for differentiation among the three groups ($F [2, 1500] = 52.614$, $p < 0.001$) and the concreteness of content words ranked as the 13th highest ($F [2, 1500] = 17.385$, $p < 0.001$). These findings suggest that, while not the most important factor for acceptance, the use of concrete vocabulary may still play a large role in determining who is and who is not published in the business community.

Intentional events: AE abstracts ($M = 7.951$, $SD = 5.923$) will use significantly fewer intentional events than AT abstracts ($M = 13.005$, $SD = 9.525$) and TT abstracts ($M = 13.709$, $SD = 9.965$) ($F [2, 1500] = 65.755$, $p < 0.001$) (see Tables 1 and 2). In the

examination of differences in intentional events between TT and AT abstracts, no significant difference was found ($F [2, 1500] < 1.000, p > 0.100$). This result suggests that Thai authors as a whole display little awareness of how intentional events are being conventionally used by NESs in the business community and may require further instruction in this area.

Cardinal numbers: The data show that the AE abstracts use significantly more cardinal numbers ($M = 67.528, SD = 40.477$) than both the AT ($M = 48.375, SD = 36.904$) and TT groups ($M = 48.666, SD = 45.388$) (see Table 1). This result suggests that NESs rely more heavily on quantitative results than their Thai counterparts. Moreover, this element accounts to a large degree, the sixth highest factor, for differences between the three groups ($F [2, 1500] = 35.757, p < 0.001$). It seems that the conventional importance of reporting statistical results within the business abstract is underappreciated by Thai authors.

Locational items: AT abstracts use significantly more locational prepositions ($M = 47.281, SD = 18.824$) than AE abstracts ($M = 42.286, SD = 16.070$), while TT abstracts use significantly fewer locational prepositions ($M = 38.227, SD = 17.213$) ($F [2, 1500] = 34.042, p < 0.001$) (see Table 1).

In addition, AE abstracts contain significantly fewer locational prepositions and nouns ($M = 0.435, SD = 0.103$) than AT abstracts ($M = 0.460, SD = 0.114$) ($F [2, 1500] = 8.295, p = 0.002$). The difference in locational prepositions and nouns between AE and TT abstracts ($M = 0.433, SD = 0.133$) ($F [2, 1500] < 1.000, p > 0.100$) is not statistically significant, but is in the direction of the AE group.

These findings suggest that Thai authors accepted for publication in the USA may be overemphasising the importance of locational items as a cohesive device in their analyses of NES' business writing. Thais accepted for publication in American journals may be overusing locational items as a simplified cohesive device at the expense of other, more expected, forms of cohesion.

Temporal cohesion: The results indicate that AE abstracts exhibit significantly more temporal cues in both aspect repetition – AE ($M = 0.806, SD = 0.159$), AT ($M = 0.737, SD = 0.277$), TT ($M = 0.713, SD = 0.247$) ($F [2, 1500] = 20.016, p < 0.001$) – and tense repetition – AE ($M = 0.836, SD = 0.159$), AT ($M = 0.768, SD = 0.261$), TT ($M = 0.762, SD = 0.218$) ($F [2, 1500] = 17.818, p < 0.001$) (see Tables 1 and 2). In a comparison of the AT and TT groups, no significant difference was observed ($F [2, 1500] < 1.000, p > 0.100$). These results suggest that NES authors may be more likely to establish textual cohesion through aspect and tense repetition, whereas Thai authors shift tense and aspect more often, perhaps leading to greater disjunction in the text.

Third-person singular morphemes: American authors use significantly fewer third-person singular morphemes than their AT and TT counterparts: AE ($M = 7.730, SD = 9.261$), AT ($M = 9.357, SD = 9.630$), TT ($M = 10.591, SD = 10.440$) (see Table 1). A comparison between AE and AT groups ($F [2, 1500] = 10.742, p = 0.026$) and AE and TT groups ($F [2, 1500] = 10.742, p < 0.001$) indicates significant differences (see Table 2).

These results suggest not only that a linguistic difference may exist between Thai and Japanese concerning third-person singular morphemes, but also perhaps a difference may exist between Thai and English third-person singular usage. Further study of this phenomenon is required.

Lexical diversity: The AE group exhibits a greater diversity in lexicon than the AT group: AE ($M = 74.302, SD = 20.530$), AT ($M = 71.707, SD = 22.316$); however, the

difference was not statistically significant ($F [2, 1500] < 1.000, p > 0.100$). In contrast, the TT group was found to contain the widest range of lexical use ($M = 76.533, SD = 27.344$) ($F [2, 1500] = 5.266, p = 0.005$), but when compared to the AE group the result was not statistically significant. Taken in conjunction with the co-referential overlap results, where the TT group displayed the lowest degree of co-referential overlap, these results suggest that AE and AT authors are more redundant in their choice of lexicon. In contrast, TT authors may exhibit greater lexical diversity but are perhaps lacking in co-referential cohesion. AE authors exhibit both a high degree of co-referential overlap and lexical diversity. This finding suggests that TT authors may not be published in American journals because of their writing, specifically their choice of lexicon, rather than (or in addition to) their business content.

Total number of words: It is useful to note that the variable which had the greatest effect on differentiation among the three groups was the total number of words ($\eta_p^2 = 0.119$) (see Table 1). The AE group contained by far the highest average number of words per abstract ($M = 258.704, SD = 64.799$) in comparison to the AT group ($M = 210.328, SD = 68.257$) and the TT group ($M = 199.970, SD = 75.390$) ($F [2, 1500] = 101.442, p < 0.001$).

This finding indicates that NESs may be more likely to overlook abstract word limitations when submitting their research for publication, whereas Thai business authors more strictly adhere to word limitations. This strict adherence to journals' demands for word limits may indicate a cultural trend in obedience towards hierarchical power structures (Ikels, 2004); on the other hand, it may indicate something as simple as NESs not counting smaller words (e.g. a, of, the) in their overall word count, while Thais include these smaller words in their overall word count. Regardless, this over-attention to word number likely results in several other perceived deficiencies in the abstracts of Thai business researchers.

Overall: Finally, as predicted, AE abstracts showed greater overall similarity to AT abstracts than to TT abstracts, suggesting that Thai authors published in American business journals conform their language and rhetoric more to the NES conventions than do Thais authors published in Thai journals.

4 Discussion

The results suggest significant differences exist between TT abstracts and AE and AT abstracts. Fewer significant differences were discovered between AT and AE publications. Therefore, the results confirm the predicted hierarchy that the most prototypical representations of the genre would come from the AE group, followed by the AT group, and lastly the TT group. These results suggest that Thai authors accepted for publication in American business journals have better learned to adapt and/or edit their language to meet the expected conventions of native English writers within the genre.

With regard to the comparison between texts published in *American journals* versus *Thai journals*, the results provide evidence that abstracts accepted for publication in American business journals use significantly (1) more *total number of words*, (2) greater *syntactic diversity*, more (3) *cardinal numbers*, (4) *locational items*, (5) *temporal items*, (6) *argument overlap*, (7) *noun overlap*, (8) *content word overlap*, (9) *stem overlap*, (10)

–to infinitives, and (11) *Wh-adverbs* than those in Thai journals. In a comparison of *American L1* and *Thai L2* business authors, American authors use (1) more *words per abstract*, (2) more *low frequency words*, (3) fewer *intentional events*, greater *syntactic diversity*, (4) more *cardinal numbers*, more *temporal cohesive devices*, (5) a smaller range of *word familiarity*, (6) fewer *third-person verb morphemes*, more *–to infinitives*, and (7) more *Wh-adverbs* than Thais.

Given that the differences between American business abstracts published in American journals and Thai business abstracts published in Thai journals (and possibly denied publication in American journals) differ significantly at each level (*word*, *sentence*, and *discourse*), it is reasonable to conclude that an NS reviewer, editor, or reader may interpret Thai abstracts as lacking in key areas of the expected linguistic and rhetorical conventions of the genre. Furthermore, failure to meet the expectations of the genre may signal to readers within the community that an author does not belong and should not be granted central membership. As a result of the prominence of the abstract, NES reviewers may correlate the research paper and its results to their reading of the abstract and review the entire paper with more scepticism. It is therefore reasonable to assume that the differences in linguistic and discourse styles limit Thais' chances of gaining optimal acceptance into American business journals.

5 Conclusion

While international business journal editors may believe that their journals actively encourage publication from L2 speakers, promote cultural diversity and do not consider English-language difficulties as a reason for exclusion, the findings of this study show that significant differences at the word, sentence, and discourse levels appear between the research published in Thai and American journals. Therefore, what business editors view as English-language difficulties may in fact be limited to superficial matters of spelling, vocabulary, grammar, and punctuation. Larger issues, such as textual cohesion, syntactic diversity, and other strategic appeals, used to situate one's research within the conventional expectations of the business discourse community may be so ingrained in editors' subconscious as to be overlooked and unexamined in the determination of L2 speakers' submissions. Simply put, the line between language and content, form and function is likely not as clear as L1 reviewers wish it to be.

Tacit linguistic and discourse generic conventions at the word, sentence and discourse levels distinguish what is published and what is not by top-tier business journals. The differences outlined in this study may assist L2 business researchers in matching their writing to the generic conventions, but it should also be used to help L1 editors to assess L2 speakers' submissions. An expanded and more explicit understanding of the genre's conventions is required on both sides.

An additional benefit of the current study is the direction it suggests for materials development for L2 and ESP teachers. As demonstrated in the current study, a large corpus of business abstracts is freely available on databases such as Medline. Thus, one immediate pedagogical implication for this study is that educators (as well as researchers themselves) may collect corpora and use the techniques highlighted in this study to better assess the degree to which their text corresponds to a prototypical or desired target text type.

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New patterns of world trade and foreign direct investment growth in Egypt

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Abstract: During the last 30 years, the world economy becomes more globalised and the international trade and FDI were growing faster than many economic activities. The fast growth in international trade is through trade in parts and components which introduced a new phenomenon known as ‘international fragmentation of production’ and changed the pattern and trends of trade in the world economy. Trade in parts and components has opened up new opportunities for developing countries to participate in world production, which may affect on increase FDI. This paper deals with the relation between trade in parts and components and FDI, both theoretically and empirically, and investigates the effect of trade in parts and components on FDI in Egypt. The empirical analysis finds that trade in parts and components has a significance positive effect on FDI in Egypt during the period 1995–2013. Accordingly, we cannot ignore traditional determinants and institutional determinants (non-traditional determinants).

Keywords: new patterns of trade; trade in parts and components; international fragmentation of production; FDI.

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1 Introduction

The increase of globalisation has changed the patterns of production in the world. There is increasing evidence of ongoing process of openness through production chains known as international fragmentation of production; this phenomenon has affected in growth of trade in parts and components. The phenomenon of fragmentation means dividing the production process into more than a step in various countries that are most suitable for each activity to get the same final product.

Since 1990s, the phenomenon of fragmentation has expanded due to information technology revolution and technological innovations in communication that allow to divide the product into two or more steps in different locations that led to reduce in cost of transportation in trade of parts and components (Jones and Kierzkowski, 2001). Secondly, development and liberalisation policies in the world economy under World Trade Organization (WTO, 2014) agreements, especially in liberalisation of services sector particularly in transportation and communication, banking and insurance, have reduce the cost of service link and facilitate the fragmentation of production process (Li et al., 2008).

The key player of trade in parts and components is Multinational Enterprises (MNEs) within vertical Foreign Direct Investment (FDI). Since the half of 1990s, about two-third of the world trade involved MNEs through vertical integration which can achieved through intra-firm trade or arms-length trade by contractual relations (Broadman, 2005). Thus, there is a strong and complement relation between FDI and trade in parts and components; MNEs may distribute the production of final goods on different branches in different countries and fragment their own technology depending on advantages and disadvantage of each location. On the other side, the MNEs may fragment the production process and have to get parts and components by outsourcing to other firms through arms-length trade in order to reduce production cost (Athukorala, 2006).

Another term of international fragmentation of production is known as global commodity chains, including whole activities in design, marketing and production. The increase in distribution network of production has opened up new opportunities for developing and transition countries mainly through buyer-driven commodity chain which concentrates on labour-intensive industries and consumer goods sectors that can be positioned to shift into producer-driven commodity chain which concentrates on capital and skilled labour-intensive industries (Broadman, 2005). Therefore, participation of developing countries in global network production helps these countries to increase competitiveness and gain comparative advantages which help them to be transformed to the export-oriented through FDI (Athukorala, 2003). The East Asia countries achieve the main centre of trade in parts and components larger than Europe and North America which influenced significantly on growth and FDI in these countries (Aminian et al., 2007).

The objective of the present study is to explain the importance of the relative recent phenomena in the international trade which is called international fragmentation of production, and also to examine the effect of trade in parts and components on the FDI in Egypt, within the hypothesis that new form of international trade and change in world trade patterns have begun to open up new opportunities for developing countries and transition economies to more integration with world economy within trade and FDI.

Following the Introduction, the rest of this paper is organised as follows: Section 2 provides the literature review divided into two parts: the first deals with trade in parts and

components in international trade theories and the second explores trade in parts and components and FDI. Section 3 provides the trends of trade of parts and components divided into three parts: the first explains overall trends of world trade, the second explores world trends of trade of parts and components, and the third provides trends of trade of parts and components in Egypt. Section 4 introduces economic variables, the international fragmentation of production variables and constructs the empirical model; conclusions are given in Section 5.

2 Literature review

2.1 Trade in parts and components in international trade theories

Two approaches have been adopted to assess the new pattern of trade that called trade in parts and components or international fragmentation of production: traditional theories of international trade approach and the studies outside these theories.

The traditional theories of foreign trade approach focused on explaining trade in parts and components under Ricardian (factor productivities) and Heckscher–Ohlin (factor prices and factor intensities) framework according to comparative advantage. Jones and Kierzkowski (1990, 2001), Deardoff (2001) and Turkcan (2011) focused on technological difference for inputs across countries, leading to the specialisation of each country in production part of the good or service according to comparative advantage that depends on the difference of the prices of parts and component in world market. On the other hand, firms depend on trade in parts and components since each fragmented production requires different factor intensive which is reflected in differences of the cost across countries. The difference in prices of parts and components in the world market independence on difference of technological performance and factor intensive is the main factor of trade in parts and components and the fragmentation will not matter if factor prices are equal in the world. Therefore, trade in parts and components may help to equalise the prices of the factor in the long run (Deardoff, 2001).

Many of the studies attributed increase in trade in parts and components to increase returns and advantage of specialisation of parts which encourage the firms to shift to disintegration production, in addition to increasing in service link and decreasing in its cost.

Arndt (2001) and Yi (2003) construct a theoretical model on role of foreign trade policies within the effects of tariff reduction on offshoring process and trade. Yi (2003) explores how fragmentation is not benefiting without tariff reduction; he focuses on imported goods from parts and components that are used to produce export goods and the role of increase in the stages of production of the goods to five or six stages in increasing technology transfer compared with two or three stages. This means that the increase in fragmentation of production can help to increase the technology used in the different stages of production. Arndt (2001) examines the effect of foreign trade policies in Heckscher–Ohlin framework and explores there is no disagreement that the trade in parts and components will increase the welfare in case of free-trade world.

Through Heckscher–Ohlin framework, Amiti (2005) provides the new economic geography literature to explore the relation between the different locations of firms which has a difference in factor insensitive and decrease trade costs. The trade cost in parts and components is the main deterrent of location of firms; the upstream and downstream

firms can agglomerate in one country which means that the capital-intensive abundant industries may locate in labour abundant countries, independent on trade cost and a departure from the framework of the foreign trade theory. Then the agglomerates of industries in one place besides increasing the direction of trade liberalisation will increase the return of various factors of production in one country (for example in many countries in East Asia). We can say there is relation between fragmentation and geographical concentration in order to reduce the cost of production. Also, fragmentation attends to agglomeration in one place to decrease total production cost in case of the increase of service link cost; we can see such type in a country like Malaysia which concentrates the production of electrical machinery in one place in the country (Kimura, 2006).

There are lot of studies on new generation of theoretical models of trade in parts and components (international fragmentation). First, there is the property rights approach which has been attend by Antras (2003), Grossman et al. (2005), and Feenstra and Hanson (2005). They explain that integration of production can decrease or remove a lot of problem like breakdown and suppliers ex-post bargaining, hence the concentration will be on investments.

Another approach is transaction cost: this theory is the most common to explain the phenomenon of fragmentation depending on the relation between economic exchanges of goods and services and the costs which include production costs and transaction costs, where the latter show the control, negotiation, contracting, adaptation and coordination costs in the case of dependence on external suppliers. Transaction costs tend to increase in the fragmentation to search for contractors or suppliers opportunism, but the more frequent transactions, the less risk to reduce the cost of monitoring and follow-up (Singh and Zack, 2006).

Grossman and Helpman (2004) explain the third approach, which is an incentive system, where the fragmentation and outsourcing relations reduce the incentive for outside or independent provider than for employee in case of the complete production in the firm. Finally, delegation of authority approach explains the reduce or loss of the control and authority of manager of project in case of fragmentation and outsourcing especially in case of multiple stages of production (Marin and Verdier, 2008).

In general, the determinants of trade in parts and components are almost different from trade in final goods; the location advantage is the main factor especially for MNEs which explain in East Asia countries that compete with each other to attract FDI within MNEs that depended on intra-firm trade (network production) by providing firms with different geographical advantage (Kimura and Takahashi, 2004).

2.2 Trade in parts and components and foreign direct investment

While many studies have focused on relation between FDI and trade in developing and developed countries, we can say the relation between FDI and trade is very complex. On the first side, there is causal relation (two-way) between international trade and FDI, and the international trade can cause FDI or vice versa. On the other side, there are substitution and complementarity relations between both international trade and FDI that depend on types and patterns of trade and FDI (Sharma and Kaur, 2013).

The increase of phenomenon of international fragmentation of production leads to increase the positive relation between FDI and trade in parts and components which clearly show through MNEs that take more than two-thirds of the world trade including

both intra-firm trade and arms-length transactions. The most of MNEs become depended on distribution of the production of product between its different branches in different countries according to comparative advantage in these countries, where they get the lowest cost of the good production taking advantage of the international production network. In addition, there are other reasons of MNEs to shift their production from one location to another according to the investment climate, market access and changes in the cost of production.

Gereffi (1999) divided a global commodity chain into buyer-driven and producer-driven commodity chains. The first exists in the branded manufacturers especially in labour-intensive industries such as furniture and apparel which concentrate in developing countries which export final goods made to the specifications of a foreign buyer. The profit of MNEs according to buyer-driven commodity is combination from design, research, sales, financial services and marketing. The link between FDI and global commodity chain clearly shows producer-driven commodity chains which tend to be by large multinational corporation that specialises in capital and skilled labour-intensive industries: automobile production networks as a common example of it.

In this case, we can conclude that the developing and transition countries can participate in a final international division of labour within buyer-driven commodity and increase their foreign investments, although this kind of production network not necessary requires FDI but associated with FDI. On the other hand, we can consider that participation of the developing countries in international production within buyer-driven commodity may give these countries a comparative advantage where it had no advantage before as a first-stage qualifier to second stage through participation in producer-driven commodity chains.

Blonigen (2001) finds that the relation between FDI and trade is different in case of final goods rather than parts and components. He uses product-level trade and FDI between Japan and the USA and shows that Japanese investments in the USA increase Japanese export of parts and components that are related to these goods. On the other hand, these investments decreased Japanese export of the same final goods (Blonigen, 2005). This means that the FDI can substitute for trade in the finished products but in case decentralise of stages of production and FDI can create trade in parts and components (Pontes, 2006).

The main factor of trade in parts and components is FDI within multinational corporation. In general, these firms investment in developing countries in the two types is either import-substituting, which is the traditional type of MNEs in these countries, or export-oriented. In recent years, network form including trade in parts and components is the main type of investment for these firms known as intra-firm trade or arms-length trade (Kimura and Takahashi, 2004).

3 Trends of trade of parts and components

3.1 Overall trends of world trade

The value of world merchandise exports was US\$ 18.3 trillion during 2005–2013, by increasing 8% during this period. The Asian and Europe regions are the main exporters of merchandise exports: China became the largest trader in 2013 where it represented 11% of the total world trade. On the other hand, the world merchandise import was US\$

18.4 trillion and increase by 7% during 2005–2013. In 2013, the USA, China and Germany are the largest importers by 2.329, 1.950 and 1.189 trillion US\$, respectively (see Table 1).

Table 1 Share of world merchandise trade of selected regions (2005–2013)

Region	Export	Export				Import	Import			
	2013	(percentage change)				2013	(percentage change)			
	Trillion \$	2005–2013	2011	2012	2013	Trillion \$	2005–2013	2011	2012	2013
World	18.33	8	20	0	2	18.410	7	19	0	1
North America	2.418	6	16	4	2	3.195	4	15	3	0
Europe	6.646	5	18	–4	4	6.598	5	7	–6	–1
Middle East	1.347	12	40	6	0	779	11	17	8	16
Africa	602	9	16	5	–6	628	12	18	9	2
Asia	6.288	9	18	2	3	6.341	10	23	4	2

Source: WTO (2014)

3.2 World trends of trade of parts and components

The previous studies depended on three alternative methods to estimate the trade in parts and components. The first approach is to measure the trade in intermediate goods from UN classification of Broad Economic Categories (BEC). Another approach is International Input–Output approach (II-O tables) as an indirect method compared with intermediate goods method by estimates import and domestic inputs of export. The share of imported inputs for exports increased during 2000 and 2009 in Japan and the USA compared with most of Asia countries (China, Korea, Philippines, Singapore, Thailand, and Indonesia), which is most probably a result of expansion of intra-firm trade of Japanese and the USA multinational firms (Maurer and Degain, 2010).

The third approach, used by Yeats (2001), uses in the almost studies in recent years depending on UN trade database on Revision 3 of the Standard International Trade Classification (SITC, Rev 3). Estimate trade in parts and components according to this approach confined to the product classes of machinery and transport (SITC 7–8); this study depends on this method to measure the trade in parts and components.

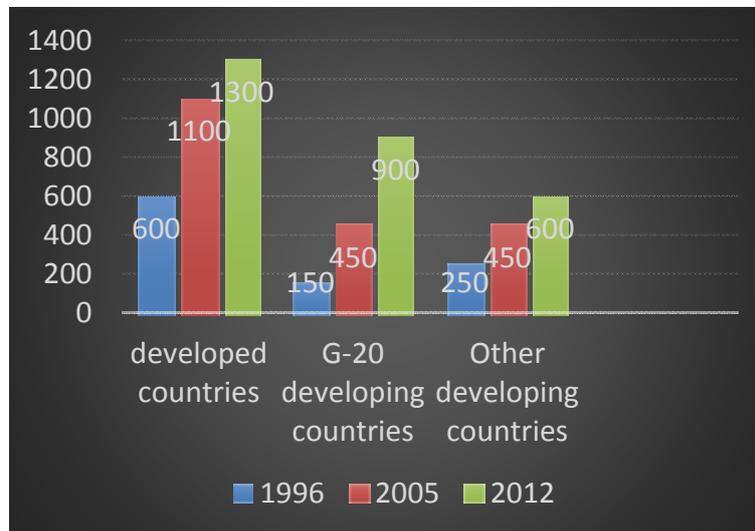
The share of imports of parts and components can explain the participation of countries in international production networks. More than one quarter of world imports in manufactured goods are represented by imports of parts and components and the world imports of parts and components increased over the past decades on the level developed, G-20 developing countries and other developing countries. The developed countries doubled the value of imports of parts and components from 600 in 1996 to 1.300 US\$ billion approximately in 2012, also increased in G-20 developing countries from 150 in 1996 to 900 US\$ billion approximately in 2012 and from 250 to 600 US\$ billion approximately in the same period in others developing countries (see Table 2).

Table 2 Import of parts and components (approximately) by country group, 1996–2012 (US\$ billion)

<i>Years</i>	<i>Developed countries</i>	<i>G-20 developing countries</i>	<i>Other developing countries</i>
1996	600	150	250
2000	740	190	380
2002	600	210	430
2005	1.100	450	450
2008	1.350	550	620
2010	1.300	550	650
2011	1.400	800	600
2012	1.300	900	600

Source: Prepare by research from WTO (2014)

Although increase the value of imports of parts and components for developed and developing countries which reflex the increase of international production networks at the level of the world, the G-20 developing countries recorded the highest growth rate of imports of parts and components during 1996–2013, specially in China which represents the main driver in the share of trade in parts and components of G-20 developing countries. Its share increased almost fivefold, from around 3% in 1996 to more than 15% in 2012 (see Figure 1).

Figure 1 Import of parts and components (approximately) by country group, 1996–2012 (US\$ billion)

Source: Prepare by research from WTO (2014)

In general, there is an increase in the value of imports of parts and components at the level of world countries, the only exception decline of trade in parts and components in 2009 following the financial crisis. Developed countries have a largest share of increase

in imports of parts and components, but there is decrease in the growth rate in this share; it decreases from 65% in 1996 to 48% in 2012 and increases in developing countries especially in G-20 from 12% to 31% in the same years (see Table 3).

Table 3 Share in imports of parts and components by country group, 1996–2012 (percent)

<i>Years</i>	<i>Developed countries</i>	<i>G-20 developing countries</i>	<i>Other developing countries</i>
1996	65	13	22
2000	62	18	20
2005	56	23	22
2010	50	29	21
2011	49	30	21
2012	48	31	21

Source: Prepare by research from WTO (2014)

In general, there is rapid increase of trade in parts and components compared with total world trade in manufacturing, but East Asia regional ranked the first on the level of the world in trade in parts and components. The degree of dependence of East Asia on international product fragmentation is larger than Europe and North America that certainly influenced significantly on many economic variables of these countries such as growth and FDI. A lot of studies suggest that East Asia is the largest country in trade of parts and components and, for that, it can attract the largest amount of FDI comparison with another developing countries and EU (Kimura and Takahashi, 2004; Aminian et al., 2007).

3.3 Trends of trade of parts and components in Egypt

Since late 1970s and early 1998s, the SITC (SITC, Rev 2) introduces and provides a more details commodity classification comparison to the original form (SITC, Rev 1). Although Revision 2 provided the measurement of parts and components and uses by a lot of studies, it does not include the machinery and transport sector (SITC 7) which includes a lot of parts and components.

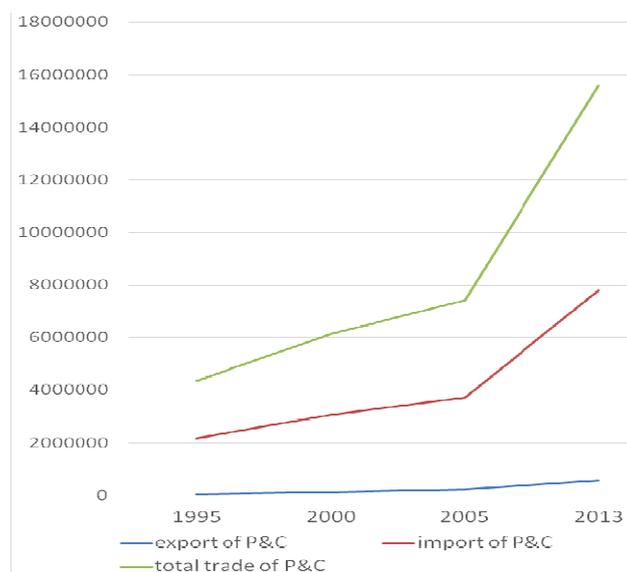
This study uses the data of parts and components from UNCTAD trade database based on SITC (SITC Rev 3), which introduces in the mid-1980s and addition a separation of parts and components in SITC 7 (the machinery and transport sector) which accounts for over 90% of the combined components trade and SITC 8 (miscellaneous goods), and the two sectors represent 80% of total world trade during 1990s and 2000s.

Table 4 explains there is increase in the trade of parts and components in both export and import in Egypt during 1995–2013. The export increases from 58,610.7 in year 1995 to 573,469.9 bn\$ in 2013 and the import also increases from 2,123,183.20 to 7,799,524.7 in the same years. There is a big jump in the trade of parts and components since 2008; the export and import of parts and components have doubled approximately only in 2008 compared to 2007, from 371,963.2 to 609,588.9 bn\$ for export and from 5,832,275.10 to 8,470,851.40 bn\$ for imports. The growth rate of trade in parts and components is 258.5% during 1995–2013 in Egypt (see Figure 2).

Table 4 Parts and components in exports and imports (bn\$) by three-digit SITC categories in Egypt (1995–2013)

<i>Year</i>	<i>Export of P&C</i>	<i>Import of P&C</i>	<i>Total trade of P&C (export + import)</i>
1995	58,610.7	2,123,183.20	2,181,793.9
1996	58,526.9	2,498,081.41	2,556,608.3
1997	76,193.5	2,772,548.40	2,848,741.9
1998	69,311.4	3,263,556.60	3,332,867.0
1999	85,438.8	3,415,567.70	3,474,006.5
2000	134,813.1	2,939,481.20	3,074,294.3
2001	110,949.1	2,429,580.50	2,540,529.6
2002	112,344.3	2,054,336.20	2,166,680.5
2003	179,356.8	2,483,512.60	2,662,869.4
2004	234,020.1	2,690,141.10	2,924,161.2
2005	232,917.1	3,487,105.60	3,720,022.7
2006	300,438.4	4,317,579.30	4,618,017.7
2007	371,963.2	5,832,275.10	6,204,238.3
2008	609,588.9	8,470,851.40	9,080,440.3
2009	576,545.7	7,770,999.20	8,347,544.9
2010	520,815.3	8,102,148.50	8,622,963.8
2011	568,469.2	8,192,715.40	8,761,184.6
2012	546,866.6	8,405,175.40	8,952,042.0
2013	573,469.9	7,226,055.80	7,799,524.7

Source: Compiled from UNCTAD Comtrade database

Figure 2 Parts and components in exports and imports by three-digit SITC categories in Egypt, 1996–2013 (US\$ billion)

Source: Compiled from UNCTAD Comtrade database

Despite many studies highlighting the impact of trade on investment growth, very few studies have examined the direct linkages or transmission mechanism of such linkages. This is because, both theoretically and empirically, the identification of the trade-induced impact on investment is not straightforward. Nevertheless, studies have specified certain channels through which trade can induce investment within trade liberalisation and enhancing factor productivity that help to stimulate investments in an economy.

4 The empirical model

In this section, the econometric model will be specified to investigate the impact of the trade in parts and components on FDI in Egypt based on the theoretical background. The empirical model will be applied on the Egypt case as can be specified in the following.

4.1 Dependent variable

As mentioned above, the dependent variable can be measured by FDI through time series 1995–2013. We represent FDI variable as the ratio of FDI to GDP.

4.2 Independent variables

There are four explanatory variables that should be used here to explain the expected changes in the dependent variable. They will be specified in the following.

4.2.1 Trade in parts and components

Many studies indicated the impact of trade on FDI, but few of it examined the direct relation, this is because the impact of trade on FDI is not straightforward. Studies depended on the degree of openness in trade to measure the effect of trade on FDI (Khanal and Shrestha, 2008). Theoretically, the increase in trade in parts and components through specialisation in production, export and import of these components is one of the attractive factors of FDI within MNEs under changes in patterns of production and trade in the world economy. According to this, we can expect that the increase of trade in parts and components will effect positively on FDI and we represent a trade in parts and components variable within the degree of openness in trade of parts and components. It is defined as the ratio of sum of exports and imports in trade of parts and components to GDP.

$$\text{Openness in trade of P\&C} = (\text{exports in P\&C} + \text{imports in P\&C})/\text{GDP}$$

We tabulated data on trade in parts and components from the UNCTAD trade database for the period from 1995 to 2013 based on Revision 3 of the SITC (SITC 7–8, Rev 3). It is important to note that trade in parts and component measured by using the reported trade data reflects only a proxy measure of fragmentation trade category.

4.2.2 *GDP per capita*

The domestic market size is one significant variable which affects on FDI in most empirical studies, from the impact of the economic growth rate as long as the foreign investor's goal is profiting. On the other hand, the increase in growth rate encourages the FDI which makes the investor expected to sustain the continuity of its activity and the flow returns (Jun and Harinder, 1996). Therefore, a positive relationship between GDP per capita and FDI is expected.

4.2.3 *Inflation rate*

The low rate of inflation is considered a magnet of the foreign investor. Countries that have a low rate of inflation are expected to be more attractive to FDI, due to decrease in the risk of expense transactions of the foreign investor which effects on their expected profit. Also, inflation rate is one economic variable that reflects economic instability in any country, which adversely affects the level of profitability and then the decision of FDI. Therefore, the negative relationship between inflation rate and FDI is expected.

4.2.4 *Institutional indicators*

The change in patterns and trends of production towards globalised production has begun to open the opportunities for developing countries to participate in global network production within more attractive FDI. For these reasons, a lot of studies focused on the impact of institutions on FDI especially in developing countries as non-traditional variables explain why investment is falling in many of these countries, although there are indications of economic improvement. A bad quality of institution increases the transaction costs that loaded in exchange and increases uncertainty about contract and economic governance. We depended on governance index which constructed for the World Bank by Kaufmann et al. (2008). Indicators from 17 different sources, constructed by 15 organisations, have been combined including six indicators for governance (Accountability, Rule of Law, Control of Corruption, Political Stability, Government Effectiveness and Regulatory Quality). These variables are subjective measures of the quality of institutions. All indicator scores have been scaled from -2.5 to $+2.5$ (Kaufmann et al., 2008).

The true model can be specified in a single equation model as can be seen in:

$$FDI_t = \alpha_0 + \alpha_1 TPC_t + \alpha_2 GDP_t + \alpha_3 INF_t + \alpha_4 GOV_t + \mu_1 \quad (1)$$

where FDI for the ratio of FDI to GDP, TPC for trade in parts and components, GDP stands for gross domestic product per capita (growth rate), INF for the inflation rate, GOV for governance indicators, and α_1 , α_2 , α_3 , and α_4 are slops coefficients with respect to the variables TPC, GDP, INF and GOV, respectively. α_0 is the intercept term, and μ_1 is the disturbance (error) term. The linear form was chosen and OLS is the method of estimation.

4.3 Data source

Table 5 Data sources

<i>Variable</i>	<i>Source</i>
FDI	World Bank: World Development Indicators 1995–2013
TPC	UNCTAD: Comtrade Database 1995–2013
GDP	World Bank: World Development Indicators 1995–2013
INF	World Bank: World Development Indicators 1995–2013
GOV	World Bank: Governance Index 1995–2013

4.4 Results

The estimation results reveal that there is a significant positive relationship between trade in parts and components and FDI as shown in Table 6. It means that the increase in trade in parts and components has opened up new opportunities for Egypt to enter the network of cross-border production to share and allow the rise of competitiveness and increase their ability to attract more FDI within MNEs under changed trends and patterns production and trade in the world economy.

Accordingly, we cannot ignore other determinants of FDI. GDP variable significantly explains the changes in GDP in the positive direction as the economic theory said, which may play an important role to support these determinants. As expected, the variable INF has a significant and negative effect on FDI. The estimation results in Table 6 reveal that there is a significant positive relationship between good governance (GOV) and FDI; it means that increasing good governance has opened up new opportunities for Egypt to attract more FDI and rise of competitiveness. Generally, the whole model seems to be significantly accepted based on the value of R^2 (0.78). In addition to the reasonable value of DW coefficient about 1.9 means no autocorrelation or serial correlation.

Table 6 Results of estimation (equation 1): the dependent variable is FDI during 1995–2013

<i>Variables</i>	<i>TPC</i>	<i>GDP</i>	<i>INF</i>	<i>GOV</i>
Coefficient	(0.42)**	(0.44)*	(-0.87)**	(1.87)***
<i>t</i> -statistic	2.07	1.43	-2.92	4.25
R^2			0.78	
DW			1.9	

Note: *t*-statistics are in parentheses

* denotes significance at 10%, ** denotes significance at 5%, and *** denotes significance at 1%, respectively.

5 Conclusion

Recent research draws attentions to the new patterns of world trade known as trade in parts and components or international fragmentation of production. There is a clear evidence that trade in parts and components is expanding rapidly than final good trade. Theoretically, the traditional theories of foreign trade (Ricardian and Heckscher–Ohlin

models) and new generation of theoretical models (property rights, transaction costs, incentive systems and delegation of authority) can explain in some cases the specialisation according to comparative advantage in parts and components but the outcome of the fragmentation on welfare, factor prices and trade is complex due to the new pattern of trade determined by many factors which are different about final goods including cost service, liberalisation of trade, exchange of technology, trade cost and rule of origin. On the other side, international fragmentation of production can create new comparative advantage from geography similar in East Asia countries which concentrated the most of trade in parts and components. This paper aims at studying the effect of trade in parts and components on FDI applied in Egypt. Although the relation between trade and FDI is complex and ambiguously independent on type and climate of investments and the two-way causal link between trade and FDI, the most of studies concentrated on impact of FDI on trade, but we believe that the impact of trade on FDI will be clearer in case of trade in parts and components that encourages specialisation in parts to attract investments or vice versa within MNEs which is the key player in trade in parts and components.

A model with FDI as a dependent variable and economic factors as independent variables is estimated, by introducing TPC variables to capture the effect of TPC on FDI in Egypt. The paper investigates that there is a significance positive relation between FDI and TPC in Egypt. In the same time we cannot ignore traditional determinants of FDI like GDP, INF and non-traditional determents that are important especially in developing countries like governance (GOV). In general, international fragmentation of production has opened up new opportunities for developing countries to participate in global production, increase their ability to attract FDI and may give these countries a comparative advantage in a good where it had no advantage before, but highlights that it considers the risks posed by this participation and the gains are not automatic. Countries that have more good domestic business environment have been found to be more integrated into global production.

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Index of acronyms

MNEs	Multinationals Enterprises
FDI	Foreign Direct Investment
BEC	Broad Economic Categories
II-O	Input–Output tables
SITC	Standard International Trade Classification

Perceptions of consumers in the financial industry under a qualitative data analysis methodology

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Abstract: This research is developed in order to better understand the feelings, sentiments, experiences and perceptions of dissatisfied consumers who use or have used the credit card Capital One in the US market. Capital One Financial Corporation is a US-based bank holding company specialising in credit cards, home loans, auto loans, banking and savings products. In terms of total assets and deposits, Capital One is the eighth largest bank holding company in the USA. This research has been conducted through a total of 1633 written reviews in the website Consumer Affairs applying a qualitative data analysis to discover the key aspects related to consumer's sentiments, feelings, experiences and perceptions. Textual statistics and cumulative coding frequency are applied in order to determine the main concerns of the customers and avoid possible problems in the future from a marketing and organisational perspective.

Keywords: qualitative research; financial industry; customer feelings; consumer complaints; customer dissatisfaction; credit card industry; qualitative data analysis; QDA; customer sentiments; US financial industry; texts statistical analysis.

Reference to this paper should be made as follows: Mongay, J. (2016) 'Perceptions of consumers in the financial industry under a qualitative data analysis methodology', *Int. J. Trade and Global Markets*, Vol. 9, No. 1, pp.33–44.

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This paper is a revised and expanded version of a paper entitled 'An applied research on feelings, sentiments and perceptions of consumers in a complaining process in the financial industry using a Qualitative Data Analysis. The case of Capital One credit card' presented at the 'SIBR 2015: Conference on Interdisciplinary Business and Economics Research', Bangkok, 4–6 June, 2015.

1 Qualitative data analysis applied to the research of consumer complaints in Capital One credit card

Qualitative Data Analysis (QDA) refers to the process gathering, organising, structuring and manipulating information collected by researchers with the goal to create relations, interpret, and obtain conclusions as Spradley (1980) suggests. The qualitative data are characterised by its cyclic and circular dynamic in front of lineal positions adopted by the analysis of quantitative data; thanks to this approach, a research can discover categories that overlap or show no relevant aspects from other that they do. The qualitative analysis goes in depth in the analysis of sentiments, personal positions, bias and experiences which appear in written texts so here we can understand the motivations of the authors of written reviews. These deviations force the researcher to initiate new cycles of revision until a strong framework of categorisation is found, being this framework resistant to a variety of texts analysed as shown by Spradley (1980).

2 ‘Coding protocols’ in the research process

A ‘code’ in qualitative work is associated to a phrase, sentence or symbolically the essence or attributes which raise sentiments and feelings located in a part of a text or visual data. Data can consist of interviews, scripts, transcripts, field notes, varied literature, videos, websites, customer’s reviews, email communications or social networks. The utilisation of the qualitative data analysis (usually described in the literature as QDA) research method and its general value has been widely demonstrated by several authors like Moore (2007), Irwin (2013) or more particularly by Srnka and Koeszegi (2007) among others.

3 The methodological improvements offered by the computer-assisted tool used in the elaboration of the paper

Computer-assisted software for QDA applications allows to code documents not only more quickly but also more reliably. It is important here to utilise research tools to extract sentence or paragraphs containing specific words or phrases.

The software used in this paper offers not just one but seven text searches and retrieval tools, allowing the research to achieve more reliable coding in less time. Looking at this topic, ‘the Keyword Retrieval tool’ can search in a single pass for hundreds of keywords and key phrases related to the same idea or concept, allowing to locate all references to a single topic, no matter which words were used to express this idea. The ‘Section Retrieval’ tool is very appropriate to automatically retrieve and tag sections in structured documents, allowing you, for example, to quickly attach codes, to turn in interview or focus group transcripts, or to code a specific section in a collection of reviews sharing the same structure, according to Provalis Research (2015).

Several authors have also demonstrated in former works the applicability of the QDA and software tools (see for example the work of Mackensen and Wille (1999), Barry (1998), and Peters and Wester (2007)) and more particularly the application in the field of financial research with the construct of robust models which explain qualitative issues difficult to measure quantitatively done by Kaczynski et al. (2014) and Bettner et al. (1994).

4 Data collection at Consumer Affairs website

This research has been conducted using the portal Consumer Affairs (C.A. from now on), which is a private, non-governmental entity that empowers consumers by providing a forum for their complaints and a means for to be contacted by lawyers if their complaints have legal merit. The complaints and reviews may be published, shared with the news media and reviewed by attorneys at no cost. Lawyers read the complaints submitted to C.A. by consumers. On occasion, the lawyers will find something they believe could form the basis of a class action suit on behalf of consumers. If a consumer has indicated on their complaint form that they want to be contacted by a lawyer, they then research the issue and, now and then, contact the consumer and file suit on his behalf. Since the founding of C.A. hundreds of class action suits have been filed on behalf of consumers. C.A. is not a party of those actions and do not profit from them. This is stated in the website portal of C.A. (2015).

This type of e-source has been chosen due to its capacity to provide ‘verified reviews’ in a high percentage. A ‘Verified Reviewer’ is represented by a customer who has created an account on C.A. and confirmed his or her email address through the C.A. verification process, or someone who has logged in through a social media site like Facebook or Twitter that has confirmed the reviewer’s identity. Verification ensures reviews are written by credible members of the C.A. community.

5 The research process implemented

A total of 1633 reviews related to Capital One credit card from May 2009 to January 2015 have been duly evaluated in this research. Each review has been added to the software tool using QDA methodology and an ‘inductive coding’ method. The method ‘inductive coding’ of qualitative data makes reference to the process of starting the analysis without any predetermined idea about which codes will be used in the research process. This type of coding really respects much better the essence of a qualitative research due to the fact that there are not limitations in the captures of ideas, perceptions, experiences or feelings. Inductive coding begins with close readings of text and consideration of the multiple meanings that are inherent in the text. The evaluator then identifies text segments that contain meaningful units and creates a label for a new category to which the text segment is assigned. Additional text segments and microsegments are added to the categories to which they are relevant. At some stage, the evaluator may develop an initial description of the meaning of a category and write a memo about the category (e.g. associations, links, and implications). The category may also be linked to other categories in various relationships, such as a network, a hierarchy of categories, or a causal sequence, as Thomas (2006) suggests.

6 Coding consistency checks used in this paper

An independent parallel coding has been applied in this research as well as with the goal of improving robustness. An initial coder (main author) carried out an analysis and developed a set of categories that constitute the preliminary findings. Then, a second coder was given the evaluation objectives and some or all of the raw text from which the

initial categories were developed. Without seeing the initial categories, the second coder was asked to create a second set of categories from the raw text. Categories obtained were two (negative and positive comments): both coders under a qualitative approach agreed on the number of codes found to be used. A total of 48 codes were retrieved by the first researcher (main author) and 56 codes were retrieved by the second evaluator and seven and nine feelings, respectively, as well. This second set of codes was compared with the first set to establish the extent of overlap. Overlap between categories and codes of perceptions was relatively low, so a third analysis and discussion was implemented in order to obtain a robust set of codes and feelings according to the findings of other authors in the literature as it is recommended by Thomas (2006). The two sets of codes obtained got merged into a combined final set made by 38 codes and six feelings.

In line with this construct, it was extracted a total of 38 codes related to the category 'Negative Factors' and six 'Feelings' taking into consideration that the goals of the research relate to the main feelings and sentiments related to customer complaints expressed by customers when using *Capital One credit card*. Here, positive comments are discarded by the author taking into consideration that the research goals take place in a complaining environment.

The descriptions and explanation of the codes extracted from the texts are, and relate to, the following:

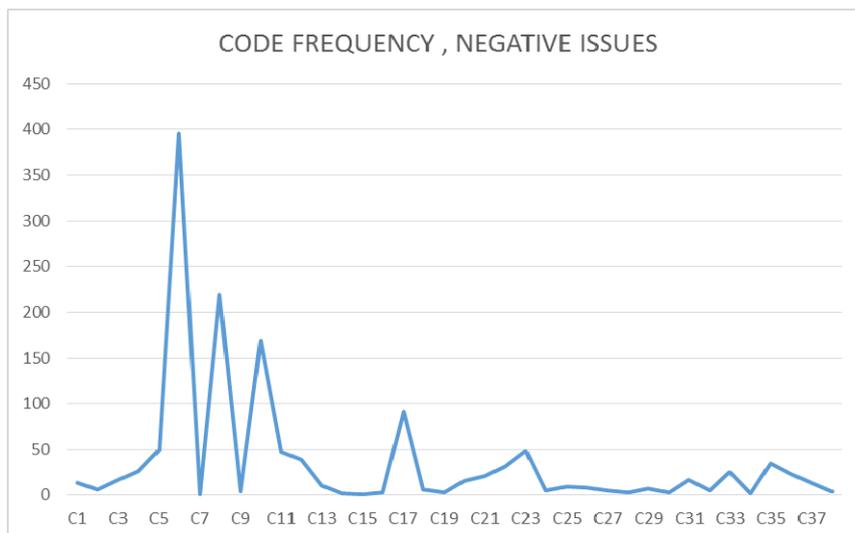
- Code 1 (C1): *Interest rate and raising rates*. Some parts of the analysed texts show unconformity of the customers of the credit card with the application of the interest rate charged. In most cases, the interest rates are superior to what the customers originally expected.
- Code 2 (C2): *Credit score and rating*. Here, customers complain in reference to the perception that the credit card company does not offer them the credit score that they really deserve, denying to increase credit or trust on the customer.
- Code 3 (C3): *Very displeased customer*. The customer in this part of the text is not pleased or displeased. Reasons can come from different explanations or origins. For example, a perception of ineffective service of Capital One or a perception of unsatisfactory service of the company.
- Code 4 (C4): *Customer confusion and general dissatisfaction*. Here, the texts express mainly confusion due to the fact that rules, protocols and policies applied in Capital One are unclear to the customers.
- Code 5 (C5): *Terrible customer service*. This is a quite holistic qualitative code. Here, the word 'terrible' is interpreted as really unsatisfactory customer service. Reasons are not explained by the code itself but it derives in other feelings as anger in most cases.
- Code 6 (C6): *Bad or very bad customer service: rudeness in Capital One people*. In this part of the text retrieval customers complain about lack of politeness, bad manners, discourtesy, insolence, irritability or vulgarity in Capital One credit card call centres and/or employees. It is important to state here that the research collects information on the perceptions of the customers, not on the situation that really happened.

- Code 7 (C7): *Small print issues*. Customers complain here about the lack of transparency generated by complex contracts or hidden paragraphs in a contract with the financial company. The company Capital One appears in some retrieved text as a generator of tiny print in order to create escape clauses.
- Code 8 (C8): *APR problems, raising interest rates unfairly, bad applications of interest rates*. The term Annual Percentage Ratio (APR) corresponding sometimes to a nominal APR and sometimes to an effective APR (or EAPR) describes the interest rate for a whole year, rather than a monthly fee/rate, as applied on a loan, mortgage, credit card, etc. Those terms have formal legal definitions in some countries or legal jurisdictions, but in general we can say that the nominal APR is the simple-interest rate for a year and the effective APR is the fee+ compound interest rate.
- Code 9 (C9): *Governmental issues*. In this section, customers complain about laws set up by the government which relate to their payments to the credit card companies. No difference or attention is given to what type of government but it is understood that given that the applied research is in the USA, we deduct that these rules apply to each member state.
- Code 10 (C10): *Late fees and extra charges*. Unclear information is given to the consumer. A late fee, also known as a late fine or past due fee, is a charge levied against a client by a company or organisation (in this case, Capital One credit card) for not paying a bill on time.
- Code 11 (C11): *Incorrect charges*. Mistakes associated with the daily operations with the credit card. Sometimes customers complain about being charged twice on the same item, or being repeatedly charged by mistake in terms like commissions and other fees by Capital One.
- Code 12 (C12): *Slow process, slow answers* (By telephone). Here, customers appeal to a lack of speed in the main company. Complains refer mainly to waiting too long in the telephone because the lines are busy or waiting too much until their case is reviewed by the appropriate person in Capital One.
- Code 13 (C13): *Online problems*. Incapacity to operate online because the system or the network is down.
- Code 14 (C14): *Credit card not working for electronic or deficiencies in its materials*. This makes reference to problems in the physical credit card, plastic-related factors or magnetic incompatibility with other devices.
- Code 15 (C15): *Bad phone service*. Only related to the phone.
- Code 16 (C16): *Lack of reward for loyalty*. Customers here complain about the lack of a special treatment for being loyal or old customers of the credit card. Customers express a lack of incentives of the company when receiving service online on the phone or relating it to the conditions to apply.
- Code 17 (C17): *Lack of transparency*. Lack trust in the company, confusion on the limitation of credit, lack of accuracy in the updates, hidden charges, unfair commercials.

- Code 18 (C18): *Payment issues*. Customers complain about problems associated with the payment process. Returned payment orders or inflexibility with the payment terms apply among others.
- Code 19 (C19): *Cancelled cards*. In some cases, the company cancels cards unilaterally for different reasons like security for example. Here, some customers express about the fact and the process.
- Code 20 (C20): *Lost accounts*. Not very common but occasionally some accounts can be lost due to computing problems.
- Code 21 (C21): *The company lies to the customers deliberately*. Some customers understand here that the company Capital One created a false statement made with deliberate intent to deceive the customer. This section includes as well the idea of 'distorting or become distorted' which is to cause a twisting from the true, natural or normal.
- Code 22 (C22): *Close account failure*. This part of text retrieval states all the exit barriers created intentionally by Capital One when customers want to close their account with the company. They can relate to pending payments, dates, contracts, protocols, signatures and many other reasons.
- Code 23 (C23): *Customer will never recommend Capital One again*. This is a code which derives in some other feelings expressed as well in this research paper. High dissatisfaction appears together with intentional feelings in the customers who at least do not help the company by recommending it to other people.
- Code 24 (C23): *Papers or documentation not received*. Contracts, cards, etc., not received by the customer. Cards and contracts could be lost or with significant delays. Reasons can be associated to external factors like transportation companies but responsibility and the ulterior complaint fall down in the sphere of Capital One.
- Code 25 (C25): *Security problems*. In this part customers experienced problems with security, mainly when third parties had access to their account without permission.
- Code 26 (C26): *The staff asks for private and confidential information over the phone* (e.g. social security number). Some customers are reluctant to offer certain type of data on the phone.
- Code 27 (C27): *Customer does not want the commercial service to call him back so often*. This factor appears probably because of the need of customers to be respected in their own free time or at home.
- Code 28 (C28): *Insolvency problems*. Some customers disagree with the way the company applies insolvency problems and ask for a much better personalised approach.
- Code 29 (C29): *Lack of responsibility of the company Capital One*. The text retrieved here shows that the company does not accept the state or fact of being accountable or to blame for something.
- Code 30 (C30): *Incompetence*. Lack of skills and abilities in the Capital One call centre people/employees to solve problems effectively in some customers.

- Code 31 (C31): *Too many phone calls* needed to Capital One to solve issues. Things are not solved quickly and protocols, and authorisations or processes become too long for customers demanding several phone calls to the company. Definitely this type of customers wants to solve their problems in few phone calls.
- Code 32 (C32): *Capital One does not allow customers to speak to a supervisor*. It is easy to understand that supervisors are for certain special cases only; this is decided by the company creating frustration in some customers.
- Code 33 (C33): *Loyalty is not recognised* (very similar to C16). A number of customers here complain about the lack of a special treatment for being loyal or old customers of the credit card. Customers express a lack of incentives of the company when receiving service online on the phone or relating it to the conditions to apply.
- Code 34 (C34): *Inefficient procedure related to fraudulent cases*. Too slow process in case of fraudulent use of a credit card. Too much verification on the side of Capital One.
- Code 35 (C35): *Communication issues* (e.g. mailing, phone, etc.). Minor issues in the communication process, e.g. losing signal on the phone, names not correctly spelled.
- Code 36 (C36): *Inflexibility*. Capital One is not perceived as flexible and agile.
- Code 37 (C37): *Do not comply with the family debt legislation*. Some customers perceive that their cases are not being treated according to the state laws.
- Code 38 (C38): *The complaint will carry on myself heavy consequences*. Some customers in their complain reviews tend to clarify and to underline the negative impact of the actions of Capital One in their lives.

Figure 1 Coding frequency of all negative issues founded



Following are the accumulated coding frequency text passages associated with the term ‘negative feelings’ after the research and the text analysis.

Table 1 Research results related to accumulated coding frequency of ‘negative comments’

<i>CODE NUM</i>	<i>ACCUM INDEX</i>								
C1	13.9	C9	3.8	C17	91.4	C25	9.6	C33	25.1
C2	6.2	C10	169.4	C18	6.3	C26	8.3	C34	2
C3	16.7	C11	47.2	C19	3.4	C27	5.6	C35	34.8
C4	26.6	C12	38.6	C20	15.6	C28	2.8	C36	23
C5	49.4	C13	10.1	C21	20.9	C29	6.8	C37	13.3
C6	395.9	C14	2.1	C22	31.7	C30	2.7	C38	4.1
C7	1.4	C15	1.1	C23	48.3	C31	16.7		
C8	219.5	C16	3.6	C24	4.7	C32	5.7		

Table 2 Research results related to accumulated coding frequency of ‘feelings and sentiments’

<i>Feeling and sentiments</i>	<i>Accumulated</i>
F1	46.1
F2	108.7
F3	169.9
F4	18.7
F5	40.2
F6	66.4

7 Results and findings on negative codes

The ranking of negative codes shows a concentration index of C_4^{57} , which means that the four most important codes found in volume within the texts and reviews concentrate a total of 57% of the reasons of complaining, which at the same time represent 794.2 out of a total 1388.13 accumulated parts of the texts coded.

The most relevant negative codes included in the C_4^{57} concentration index and issues found related to the complaints of Capital One consumers are as follows:

Code C6: This research demonstrates that the first code relates to the category ‘bad or very bad customer service: rudeness in Capital One people’ is the most relevant by far. The QDA suggests that the company should improve its manners so consumers do not feel the service (mainly on the phone) as rude. It looks like rational to assume that the rudeness perceived by customers of the people in the phone working for Capital One appears as a response to comments from the consumers as well, although this is only a hypotheses neither validated nor demonstrated yet.

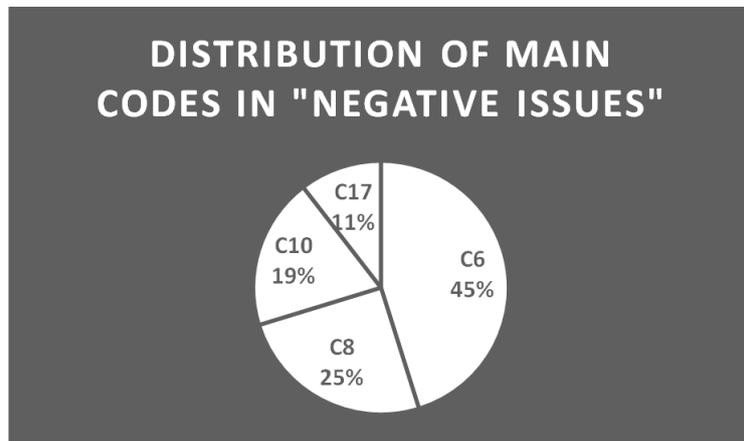
Code C8: APR, problems, raising interest rates unfairly, bad applications of interest rates. Most of consumers explain that found unclear rates and extra charges are not expected.

Surprising fees in their credit cards and other costs are not expected. The APR policy varies depending on flows, expenses and days and this is clearly a source of dissatisfaction in customers.

Code C10: Late fees and extra charges. Unclear information is given to the consumer. Most of the consumers here appeal to very high fees when being delayed in some payments. This is consistent with the statement that most credit cards increase their profitability when consumers get delayed in payments. Even if the delays are only 24 hours.

Code C17: Lack of transparency. Lack trust in the company, confusion on the limitation of credit, lack of accuracy in the updates, hidden charges, and unfair commercials. Most consumers explain in their written reviews that the company hides crucial information to them. Customers perceive that Capital One is not revealing all his policies deliberately in order to increase profitability.

Figure 2 Distribution of main codes related to negative issues



Source: Own source

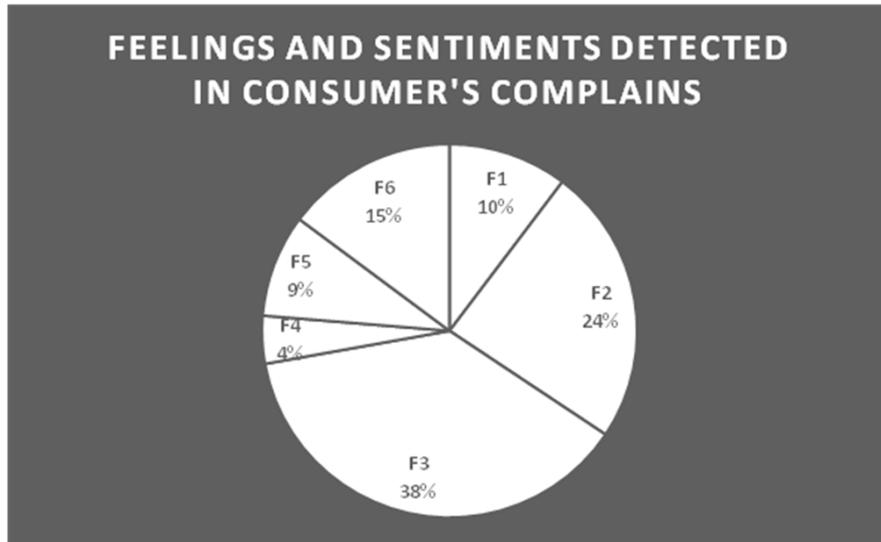
8 Results and findings on feelings from consumers

The specifications of the main feelings and sentiments detected in the research are as follows:

- Feeling 1 (F1): I feel very dissatisfied with Capital One as an entity.
- Feeling 2 (F2): I feel that Capital One is a fraud and/or it breached the contract.
- Feeling 3 (F3): I feel frustrated or with extreme frustration and anger.
- Feeling 4 (F4): I feel that the company Capital One is greedy.
- Feeling 5 (F5): I feel I should/will lawsuit the company.
- Feeling 6 (F6): I feel that the institution hides itself and does not face problems properly.

The statistics found on these feelings are as follows:

Figure 3 Distributiosn of main codes feelings and sentiments in consumers complains



Source: Own source

It appears a conclusive sensation of ‘frustration, extreme frustration and even anger’ in a 38% of the coded feelings (F3), associated to the idea that ‘I feel that Capital One is a fraud and/or it breached the contract’ in another 24% of the coded text (F2). The perception that the institution is ‘hiding itself from customers and does not face problems properly’ (F6) appears in 15% of the coded text. All these three factors sum a total of 77% of the total feelings expressed by the consumers.

9 Limitations of the research

The research explores in depth a total of 1633 reviews of complains from consumer’s perspectives. This author believes that this research can be improved by an ‘in-depth evaluation’ and analysis of the phone conversations (in case that it is legal and in case that it does not represent a violation of data privacy). This step would help the validation process of the veracity of the written reviews and would reduce possible exaggerations or distortions from some consumers expressed in situations of extreme anger. The written reviews appear in an internet portal which operates as a social network, and this type of communication is really valuable in order to understand honesty in relation to feelings due that spontaneous comments are very valuable, according to the findings of Berg (2004) from a qualitative point of view.

Still it is really difficult to guarantee or demonstrate that these are common problems to all credit card companies in the USA or in other markets or countries. In the future it would be required a wider perspective of this research and to extend the same research protocols to other companies in order to go beyond this particular case study in Capital One.

10 Conclusions and managerial implications

The main challenges that Capital One and its managers should face when consumers complain relate to the areas of reduction of anger in consumers, by following the ideas that superior cognitive control abilities are associated with lower levels of anger according to the findings of Wilkowski et al. (2010). Capital One should implement mechanisms in order to reduce anxiety in its consumers when complaining. This can be done for example by allowing them with the possibility to speak to a supervisor or by reviewing the problems more carefully than what they actually do.

It is important for Capital One to make sure that its employees avoid completely the possibilities of being rude or being perceived as rude in front of the consumers, even if we have no clear evidence that the evaluated reviews are not partially distorted by emotions and feelings of anger or frustration of the same consumers.

Finally, APR and 'other hidden fees' could become a relevant and significant problem for Capital One. All issues related to APR policies should be stated and clarified more clearly before starting transactions with consumers due to the fact that confusion in this field creates feelings of fraud towards Capital One, which in some cases might derive in legal action. More transparency using, for example, warnings and alerts to the customers through SMS or email alerts before this kind of problems arises. By doing this, it looks rational to believe that the amount of complains might be reduced and the brand reputation might be improved according to several sources of literature review.

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Global business vulnerabilities in cloud computing services

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Abstract: Cloud computing is a new structure of information technology that is becoming the main part of the new model of business environment. Cloud services provide easy, quick and scalable business setting and development across the globe. However, issues regarding such new hype of technology do not come without obstacles. These issues have to be addressed to avoid any possible vulnerability in cloud computing environment. After overviewing the advantages and disadvantages of cloud computing types and services, this paper identifies vulnerabilities issues in cloud computing and categorises them by measuring a score for seriousness and impact to conclude the percentage of importance for each of the vulnerability categories.

Keywords: cloud computing; cloud services; cloud malware attacks; cloud vulnerabilities; business security; cloud ethics.

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1 Introduction

As most types of advancement in application of information technology, cloud computing has dramatically changed how business applications are built and run. This type of information technology has a leap of change in different aspects of fast businesses application delivery. Businesses use cloud computing service like 'Platform as a Service (PaaS)' for simplicity, scalability and reliability of running the business. Device mobility augmented with cloud services provides an excellent attraction to

business operations. For example, businesses in construction industry can auto-sync their mobile devices with servers in the cloud. This gives them a global access to their main headquarters from their mobile device like iPhone or similar. Businesses and consumers already started using cloud computing services as a facility of data storage and collection, as well as communication and collaboration (Simmhan et al., 2008; Yogesh et al., 2009). The main benefit to businesses is the time and cost-saving of IT technical set-up and troubleshooting which are highly valuable issues for small firms. Actually small- and mid-sized companies can benefit from cloud computing by freeing up company's employee resources to spend more time on increasing sales and profits. However, there are many different types of clouds, as well as different types of services offered. Each of which has a different types of issues and risks that have to be addressed and studied before joining the cloud. Technically, the main weak bottleneck of cloud computing is that it is purely based on the 'internet'. Hence, if connectivity failed for one reason or another, the whole business will freeze.

Ethical behaviour forms an important part of driving the success of cloud computing environment. Cloud provider has to guarantee that their professionals handling client's data and software are dealt with in highly ethical manner. Businesses must be assured about the security and integrity of their data. Cloud providers must ensure that there is a mechanism to measure the ethical behaviour of their employees in different sections of their corporate. Professionals who work with information in cloud technology have access to sensitive information and tools that are important to business operations. Cultural background has a large influence on the typical employee(s) behaviour in corporate life. For example, Al-A'ali (2008) studied the effect of computer ethical behaviour on individuals coming from Muslim cultures. Stahl et al. (2010) also studied the emancipatory issues of ICT in a specific Egyptian culture. A statistical study by Kouatli and Balozian (2011) compared the practical perception of IT ethics as opposed to the academically taught perception of IT ethics. The study resulted in the main conclusion that the unethical violations were due to the existence of ill-defined boundaries of ethical and legal standards when the study was conducted. Issues related to the impact of ethical behaviour to cloud computing environment were raised by Kouatli (2014a) where he (Kouatli, 2014b) explored vulnerabilities issues across the history of computing development reaching the new era of cloud computing. Recent vulnerabilities in cloud computing have been tackled by quite few researchers. For example, Dahbur et al. (2011) highlighted, categorised and surveyed cloud security issues with proposed recommendation to reduce the vulnerabilities risks. Another survey of cloud computing services is tackled by Subashini and Kavitha (2011) where security risks associated with cloud computing were conducted. Issues of risks can be lowered when virtualisation technology augmented with cloud technology. Virtualisation allows users (customers) connected to the cloud to appear to be fully utilised by the user (disk, server, devices, etc.) and it is becoming part of generic cloud technology necessary for its operation. Lombardi and Di Pietro (2011) showed how virtualisation can increase the security of guest virtual machine as well as cloud infrastructure. They also proposed a system that can be deployed to different cloud solution in order to monitor the integrity of guest and infrastructure components. As for business perspective of cloud computing, Marston et al. (2011) identified and reviewed the strength, weaknesses, opportunities and threats of cloud computing. In a similar manner, Potey et al. (2013) highlighted and categorised cloud security issues, threats, vulnerabilities and control. Cloud threat and security were

also clarified by Zissis and Lekkas (2012). More recently, a comprehensive study of cloud computing security and privacy has been studied by Bodkhe and Dhote (2015) where vulnerabilities, threats and attacks have been explored with a proposal of calibrating these attacks and provided an insight of possible future security perspectives. Also, Ali et al. (2015) present their proposed solution to security issues where mobile cloud computing was also highlighted. Other similar surveying articles regarding cloud computing security and vulnerability issues can also be found in Aldeen et al. (2015) and Khalil et al. (2014). None of the published surveys and reviews about cloud computing includes ethics and good control of code of ethics as part of the framework of security and vulnerability issues. Kouatli (2014c) suggested the ten commandments of cloud security management in order to include the control of possible insider threat and vulnerabilities, as well as to follow security rules and procedures effectively. This paper will also view the vulnerabilities of cloud computing inclusive of personnel behaviour in terms of negligence, unethical behaviours as well as militia's behaviours.

2 Overview of cloud computing

Cloud computing is the new concept of information technology utilisation to drive businesses. The attraction of cloud computing to businesses is that it reduces the IT infrastructure cost of the company by immediately providing the services to the businesses and hence cutting down time and cost to set-up process as well as reducing the required skills within the company. Cloud computing official definition of characteristics was stated by the National Institute of Standards and Technology (NIST, 2013): 'cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction'. NIST defined five essential characteristics of cloud computing. These are: on-demand self-service, broad network access, resource pooling, rapid elasticity or expansion, and measured service. It also lists three 'service models' (software, platform and infrastructure) and four 'deployment models' (private, community, public and hybrid) that together categorise ways to deliver cloud services.

Cloud providers have proved to be very beneficial for the establishing businesses that have the urge to quickly grow in future. There are three different types of clouds and three different major services in the cloud (Software as a Service (SaaS), PaaS and Infrastructure as a Service (IaaS)), each of which has advantages and disadvantages as will be discussed in the following sections.

2.1 Advantages of cloud computing services to business environment

The main attraction of cloud computing is that it makes maintenance of software and hardware easier as installation is not required on each end-user's computer. It also enables server and storage devices to be utilised across the whole corporate using virtualisation concept. The main advantages of cloud computing services in general are given below.

2.1.1 Reduced IT costs

No initial set-up cost is needed for businesses adopting cloud computing services. Also, operation costs are much lower as there is no need to pay for upgrades and antivirus software, etc. Businesses pay for what you use only. The overall IT expenses can reduce the need to invest in certain hardware, software and networking management.

2.1.2 Scalability

Cloud computing allows businesses to expand or reduce IT resources depending on the changing needs of the business by simply requesting more and expanded services.

2.1.3 Accessibility

Information and applications can be accessed from anywhere and with from multiple location. This is an extreme attraction to businesses to drive them to adopt the cloud. Globalised businesses find this feature very valuable.

2.1.4 Automatic upgrading & updates

Operation cost will drop dramatically by businesses adopting the cloud. This is because the cloud service provider will automatically keep the latest version of the software you are working with. Automatic updates can also reduce in-house implementation costs for the user.

2.1.5 Faster time-to-market

Businesses can start using the cloud services shortly after requesting that service. No need to wait for set-up time that may require servers, network devices, storage devices, etc., and that may also need high expertise in information technology as well as security techniques.

2.1.6 Better data protection

Service providers do have the right skills and technology to protect customers' data. However, due to some incidents discussed later, this can be arguable as some businesses showed concerns about placing their data in the cloud.

2.2 Cloud deployment models

Large pools of resources can be connected via private or public networks to provide dynamically scalable infrastructures for application, data and file storage. Firms can choose to deploy applications using one of the four deployment models. These are: *public, private or hybrid* clouds.

2.2.1 Public clouds

Public clouds are operated by third-party providers, allowing customers to benefit from reducing infrastructure costs as it is spread across all users. The main advantage of public cloud infrastructures is that they are typically larger in scale than an in-house developed

enterprise cloud, which improved the 'on-demand' scalability. As it is operated and managed by third party, all customers share the same infrastructure configuration and security protection. Initial cost is minimal, but if data are stored for a long period of time, it proves to be expensive. Accessibility, availability and reliability criteria make the public cloud more popular than private cloud. Physical infrastructure of public clouds may also be owned and managed by a group of organisation and, hence, in such case, is usually called 'community cloud'. All three services IaaS, SaaS and PaaS are available in public clouds.

2.2.2 Private cloud

Private clouds are specifically built for individual enterprise allowing them to host applications in the cloud, while addressing concerns regarding data security and control, which is often lacking in a public cloud environment. Initial cost is expensive, but gets minimal at later stages of using it as a service. There are two variations of private clouds: the externally hosted and the internally hosted. The *externally hosted cloud* facilitated by service provider with full guarantee of privacy which is usually preferred for organisations trying to avoid risks due to shared resources. The *internally hosted cloud* built within an organisation's own data centre. Although there is limitation to size and scalability, complete control and configuration management are under the internal administration. As the infrastructure is owned by the organisation, only SaaS and PaaS services are available in private clouds.

2.2.3 Hybrid cloud

Takes the best of both options where organisation can partially or fully control the cloud provided by third-party cloud providers. Hence, control flexibility and on-demand scalability are available in this type of cloud.

2.3 Cloud services advantages and disadvantages

Cloud computing revolutionised the concept of information technology delivery by introducing the cloud technology in a form of services. Similar to electric power service, cloud computing provided services where you 'pay as you go' in a form of metered service. Businesses can choose from three main services offered by cloud providers: IaaS, SaaS and PaaS.

2.3.1 Infrastructure as a Service (IaaS)

IaaS is the cloud model in which an organisation outsources the equipment used to support operations, including storage, hardware, servers and networking components. The service provider owns the equipment and is responsible for housing, running and maintaining it. Clients typically pay on a 'per-use' basis and, in return, service providers guarantee administrative automation as well as internet secure connectivity with dynamic scalability. IaaS is popular in the data centre where software and servers are purchased as a fully outsourced service and usually billed on usage and how much of the resource is used – compared to the traditional method of buying software and servers outright. IaaS is an excellent mechanism to start the required business application quickly and with

minimum cost and effort. The main disadvantage would be employees accessing information that might not be eligible to access. Hence, a governance and usage monitoring would be necessary. Desktop virtualisation would be necessary when using IaaS which is the concept of isolating a logical operating system instance from the client accessing it. There are different conceptual models of desktop virtualisation, which can broadly be divided into two categories based on whether or not the operating system instance is executed locally or remotely.

2.3.2 Software as a Service (SaaS)

SaaS is a cloud model where software applications hosted by the service providers and made available to customers/subscribed organisations via the internet. SaaS becomes more popular as the web services like service-oriented architecture (SOA) are well developed and maintain high reliability. Tremendous benefits from SaaS delivery start from easier administration and hence lower maintenance costs. This would be inclusive of all necessary patches and updates, insuring compatibility across multiple platforms and more efficient collaboration via global accessibility. Because SaaS applications are accessed from a remote server rather than installed on individual machines, it is easy to maintain the software for multiple users. For example, when the remote software is updated, the client interface is also updated for all users. This eliminates incompatibilities between different software versions and allows vendors to make incremental updates without requiring software downloads. Additionally, users can save data to a central online location, which makes it easy to share files and collaborate on projects.

Several types of SaaS applications are available. For example, Google offers a suite of online applications called Google Apps. These include Google Docs, which allows users to create and share documents online, Google Sites, which enables users to collaborate on projects via a custom web interface, and several other applications. Some SaaS software is free to use, while other online programs require an upfront payment or a monthly fee. Enterprise SaaS applications often require a commercial license, but online software licenses are usually less expensive than individual software licenses. Because of the many benefits of SaaS, it is becoming an increasingly common way to distribute software. SaaS offers substantial opportunities for organisations of all sizes to shift the risks of software acquisition, and to move IT from a reactive cost centre to being a proactive, value-producing part of the enterprise. Benefits of the SaaS model include easier administration, easier collaboration, automatic updates, compatibility and global accessibility.

2.3.3 Platform as a Service (PaaS)

PaaS is an extension of SaaS. It is a concept that describes a computing platform that is rented or delivered as an integrated solution, solution stack or service through an internet connection. PaaS lies in the middle between the IaaS and SaaS layers. On top of SaaS, PaaS is a way to rent hardware, operating systems, storage and network capacity over the internet. PaaS allows customers to run their own application and/or develop and test new ones. This would result in benefits to developers where necessary operating system features can be updated whenever needed as well as allowing software development teams to collaborate globally. Services at the PaaS layer differ from infrastructure services in that they eliminate the need to create and manage instances of virtual machines. This is

usually done by presenting clients with Application Programming Interface (API) instead of virtual machines. With PaaS, the development tools themselves are hosted in the cloud which is accessed via a web browser. Fewer technical resources are needed in this case to develop and deploy cloud applications. At the same time, PaaS clients still retain greater opportunities to customise their applications than permitted by customers of SaaS. The main advantage of PaaS is that organisations avoid the virtual machines administration complexity. At the same time, developers can customise applications with custom coding, a feature not available to SaaS clients. PaaS clients do not need a staff to install, optimise, or maintain either the hardware or the virtual machine environments. They can choose the type of platform that best suits their needs and immediately begin creating applications that can be hosted on the cloud as soon as they are complete. Like other cloud computing services, developing and deploying applications utilising the PaaS model require little or no upfront investment. Billing is performed on a pay as you go basis.

On the downside, PaaS solutions do not allow the flexibility of an (IaaS) offering. PaaS clients cannot necessarily create and delete multiple virtual machines as easily as their IaaS counterparts. Another potential pitfall is that the flexibility of offerings may not meet the needs of some users whose requirements rapidly evolve. PaaS does not represent a complete product in the way that SaaS offerings do. An organisation must still undergo a development effort in order to design, build, and test programs before they can be deployed to the end-users.

3 Common threat in the cloud

As most types of business information technology, security would be the main issue which is more vulnerable when it comes to cloud computing. Hackers would have more opportunity to practise their malicious attacks to businesses using the cloud. It would be beneficial in this case to list the major malicious attacks that cloudy businesses could be subjected to. The list of all types of malware/hacking techniques is rather endless and the technical details are beyond the scope of this paper. Hence, only the major malwares specifically related to cloud attacks will be reviewed in this section with minimal technical description of each.

A logic bomb is a hidden program in the target computer and set to trigger to destroy data at a future predetermined date and time. This is a much used technique of disgruntled employees after being fired. They just get their revenge from their employers, sometimes without being noticed.

DDOS (flooding attacks) stands for distributed denial of service attacks, which prevent computer resources being available for intended users, by flooding for example web servers with more data than they can process, thus forcing websites offline. An attacker can throw a huge amount of requests forcing the cloud to expand automatically (scalability), until the cloud reaches a request limit it cannot exceed. Hence, the system uses all available resources and could not respond to provide services to legitimate users. Attackers in this case would be capable of attacking the server and application residing in it.

Spyware is a program that records typed data from an infected computer, and then forwards the data back to the attacker, used in stealing passwords and credit card details.

Botnets (or zombies) are network computers taken hostages by malwares, and remotely controlled, used usually to send spam e-mails and distributed denial of service attacks.

Investigation attacks: using ping command, a malicious intruder can sweep the target network to determine which IP addresses (computers) are alive. Then the second step is to check which port (socket) is active on that IP address. The intruder in this case can identify the targeted servers to be attacked. The *ping* command tells the attacker what IP addresses are available: in this case, packet sniffing used for *eavesdropping*. The information gathered by eavesdropping can then be used to pose other attacks on the network.

Cloud malware injection attack: It is an attack that tries to damage application or a service by injecting the intruder's credentials as if it is a legitimate one. If successful, attacker would upload virus program into the cloud structure.

Password attacks: Password attacks usually refer to repeated attempts by hackers to find passwords. Password attacks can be implemented using several methods, like brute-force attacks, Trojan horse programs, IP spoofing, and packet sniffers. Brute-force attack is the most popular technique, using a program that runs across the network. When an attacker gains access to a resource, he has the same access rights as the user whose account has been compromised. If this account has sufficient privileges, the attacker can create a back door for future access.

Phishing is one type of social engineering where data theft by phishing is the notion when a hacker tries to trick others into providing sensitive information, such as credit card numbers or passwords. The phisher disguised as a trusted party or a friend to access sensitive information.

Man-in-the-middle attacks (also known as session hijack): A *man-in-the-middle attack* requires that the hacker has access to network packets that come across a network. In this case, the hacker just monitors the packets via packet sniffers until the time he/she needs to interfere (for example when a bank is ready to wire money or provide details of account number to a client). The hacker then masquerades himself/herself as the recipient by altering the TCP session (also called session hijack). Man-in-the-middle attack alleviation is achieved by encrypting traffic in an IPsec tunnel, which would allow the hacker to see only cipher text.

Browser security: *Web browsers have to make a secure connection whenever a customer requested services. This is usually termed as 'Secure Socket Layer' or SSL.* SSL is the connection between the customer and the cloud providers usually via a third part company.

Masquerade/IP spoofing attacks: *IP spoofing* occurs when intruders create IP data packets with falsified source addresses. An attacker is usually outside the network and pretends that he is a trusted party. Normally, an IP spoofing attack is limited to contamination of data or commands into an existing stream of data passed between a client and server application or a peer-to-peer network connection.

4 Cloud computing business vulnerabilities

A statistical study on cloud vulnerability incidents was conducted by 'Cloud Security Alliance' (2013) where the study revealed that 29% of threats were due to insecure interfaces and API, 25% were due to data loss and leakage and 10% due to hardware failures. This summarises most of the detailed vulnerabilities that most researchers are trying to identify and provide solution for. The study also shows that vulnerability incidents are dramatically increasing (incidents were more than doubled from 33 in year 2009 to 71 in 2011). More recent study reported by Strategic Marketing Services (CSO) (2015) in June 2015 studies the cloud security concerns with perceived effectiveness of traditional security solution in a cloud environment where the key findings were (i) 45% of respondent believed that it is more difficult to maintain the visibility of security and vulnerabilities with cloud computing; (ii) half of them were also very concerned about data residing in public cloud; and (iii) 80% believed that traditional networking security solutions may not be effective in cloud environment.

Such statistics indicates that cloud computing started to be accepted in industry as a platform, but issues of concerns of security and vulnerabilities still exist. These can be summarised in the followings.

4.1 Reliable internet availability

Unless the internet connection is reliable and available all the times, business operations and data security and protection may be compromised. Today's technology maintains high reliability of internet connection. However, if its connectivity is lost for some reason, then the whole business continuity would stop during that downtime period. Hence, as it can be seen in Table 1, it was given the scale of 1 (lowest) in case of unavailability due to physical disconnection of the internet and an impact scale of 5 (highest), in case it has happened.

4.2 Data security and protection

As there is no appropriate regulation to data protections, data storage security and protection is heavily dependent on trust between the business and the provider as well as a binding contract detailing the legal responsibility of the service providers in terms of security and protection of data. Data encryption is recommended before data are sent to PaaS cloud providers. This would be necessary to ensure secure environment when using PaaS. However, this would result in slow system performance. Using technological tools to maintain security and protection is becoming a standard procedure and well documented and hence easily maintained. Again, if these tools were not monitored appropriately it would result in an exposure to possible security breach or data contamination.

4.3 Data location and replication

One advantage of cloud services is that business data are replicated in a multiple version across the globe in order to maintain backup and integrity of the data. However, the disadvantage of too many replication is that the professional themselves working for the cloud providers may not be aware of how many automated replica produced in the cloud.

Moreover, a replica might be located in different countries where there is no clear legislation about data security and privacy. Also, as part of disaster recovery plan, steps to maintain business continuity against possible threats like fire and natural disaster have to be clarified by the cloud service provider. Businesses must be aware of this fact and must be discussed as part of contract negotiation with the cloud providers. It is unlikely that replica of the data to be exposed by other parties in a different country. However, if it did happen, then the impact is high.

4.4 Password management and context awareness access

As SaaS provides applications from the cloud, the main risk would be multiple passwords accessing applications. Single sign-in would solve this problem but reduces access-ability in case a user left signed-on in one location, then the system would not allow the user to login from different location without formal sign-out from previous location. In addition to the password management, clients in a globalised business environment using mobile devices like tablets and smart phones do not guarantee who, why and from where that specific customer or employee requests to access specific information. Although adds complexity, context awareness access investigation would be necessary to identify reasons for a user to request access/information. Although technological tools may help in password management and context awareness mapping of user to the relevant data sections, monitoring of such tools would require reasonable effort to maintain it.

4.5 Cloud ethical standards

History of information technology proves that technology is always ahead of regulations. Cloud computing is of no exceptions. Code of ethics to protect data on cloud is not well developed yet and needs further study not only to provide policy and regulations but also to motivate and measure ethical behaviours. For example, ethical dilemma might emerge when the same IT professional serves two different clients in the same industry sector (serving two competitors). This raises an ethical dilemma situation where the question of business strategy, methodology and secrets might be exposed to competitors via the IT professional who will act as the intersection link between them. Although this can be avoided by either allocating different IT professionals in case of competitive clients, the implementation might not always be easy in case of too many business competitors requesting the same service.

4.6 Accountability

Accountability for security and privacy in public cloud cannot simply be delegated to a cloud provider. Businesses must conduct careful planning of the security and privacy aspects of cloud computing solutions before implementing them. To do this, full understanding of the public cloud computing environment offered by the cloud provider would be necessary. Cloud providers on the other hand have to ensure that a cloud computing solution – both cloud resources and cloud-based applications – satisfies organisational security and privacy requirements. IT professionals must be accountable for any step taken during day-to-day operations like tape backup, managing and replication data, securing data encryption, etc. This can be easily handled via a log

detailing individual tasks conducted by all IT professionals. However, the impact of any misconduct of actions would be medium to high depending on the level of security/protection breach.

4.7 Auditing and full governance of IT services

Unless a good control of IT governance and access security by the organisation, unwarranted access of services by employees might result. Before joining the cloud services, businesses must have appropriate plan of access control to specific employees requesting specific service. Cloud service governance frameworks would be recommended to prevent employees accessing information or services they are not permitted to use. Also, *auditing* cloud computing requires identification of risks, evaluates mitigating controls and audits the risky objects. A good framework would be required to think about the IT risks and, thus, assist the IT auditor in conducting an effectual risk assessment. IT auditors must be from a third party auditing company and not an internal auditor from the cloud service providers. Businesses must insist to have access to the auditing report or may negotiate to involve their own business auditors in the process of cloud service provider's auditing process. For example, businesses using service providers may request to audit the data storage/backup procedure at the service provider's site. The dilemma is that service providers may refuse such request due to confidentiality of services as well as other businesses privacy.

4.8 Mobility access and context awareness

Smartphone users have increased suddenly over the past two years. Over 100 million Android phones shipped in the second quarter of 2012 alone. This has encouraged hackers to target these mobile devices and whole new types of vulnerabilities started to emerge. For example, a new business model for Android malware attacks is to install *fake apps* that secretly send expensive messages to premium rate SMS services. Newer versions of fake applications uses a form of Trojan to gain root access, installing malicious code and communicate with a remote website to further contaminate data or to download and install additional malware. This allows these Trojans to avoid detection and removal, while recruiting the device into a global botnet. Eavesdropping on incoming SMS messages has also been noticed recently allowing data leakage of sensitive information like internet banking services where mobile transaction confirmed to customer via SMS which might include authentication details.

Perhaps, the main advantage of mobility access of information was the improved productivity from an employee as it allows ease and fast information exchange for corporates and hence most corporates allow their employees to Bring Their Own devices (BYOD) and started to gain popularity by 2011.

Hence, a policy was needed for such new concept emerged in the corporate strategy of processing information. BYOD security relates strongly to the end node problem, wherein a device is used to access both sensitive and risky networks/services. BYOD can result in data breaches in case of phone loss and accessed by untrusted person(s) who can view and edit any unsecured data on the phone. Also, when the employee leaves the company, company data may still be present on their own devices. Samsung (2013) conducted a survey on BYOD in 2013 and found out that 61% of companies have some form of BYOD policy with only 15% of companies prohibiting the use of mobile

devices. Moreover, the study showed security of 84% as the leading factor impacting the future BYOD policy. CISCO (2013) studied the financial impact of BYOD to companies where their study showed that companies across the globe are making productivity gains when using BYOD where the major cost-savings occurred in three areas:

“Hardware costs: Employees purchase devices previously bought by the company. Support costs: Companies can actually reduce support costs with BYOD, as CISCO did, by implementing community support, wikis, forums, and other streamlined support options. Telecom costs: By migrating some mobile users from corporate data plans to self-funded plans, companies can cut telecom costs. Companies have reported being able to migrate about 20 percent of corporate users to self-funded plans in this way.” (CISCO, 2013)

5 Cloud vulnerability analysis

From the above discussion, vulnerabilities can be defined in different categories, each of which might be composed of multiple vulnerability types. Hence, in Table 1, based on above discussion, appropriate vulnerability categories and types have been identified where each type has been given a ‘Likely’ score of happening. Another score was estimated based on the impact of such vulnerability in case it happened, and then weighted score as well as percentage for each type or category can be developed. For example, in Table 1, access control to systems can either be adopted by brute-force (likely weight is 1 and the impact in case happened is 2 and hence the score is 2) or DNS contamination with likelihood of 2 and impact of 3 and hence the weighted score is 6. Figure 1 shows the histogram of vulnerability categories chart showing the highest vulnerability category to be the mobility access (BYOD) which is understandable as no specific policy and mechanism have been formally defined yet.

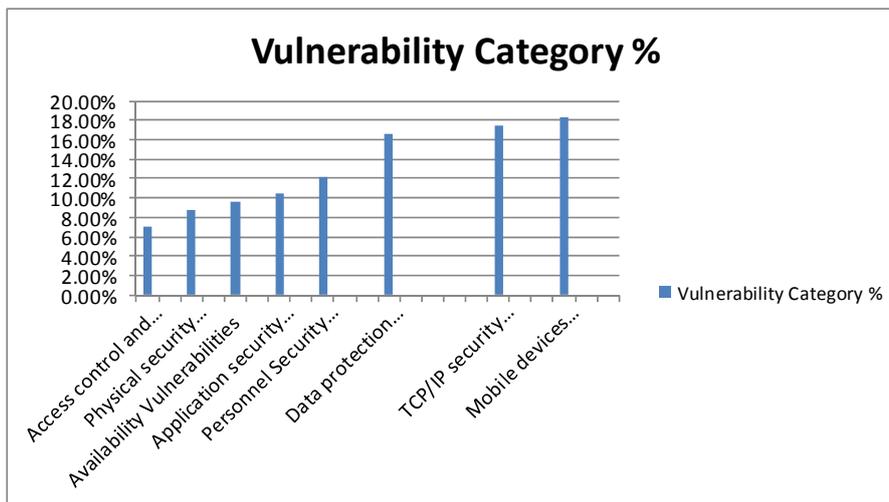
Table 1 Vulnerability analysis in cloud computing environment

<i>Vulnerability category</i>	<i>Vulnerability type</i>	<i>Likely weight</i>	<i>Impact</i>	<i>Weighted score</i>	<i>Vulnerability (%)</i>	<i>Vulnerability category (%)</i>
Access control and authentication vulnerabilities	Brute-force attack	1	2	2	1.74	6.96
	DNS database contamination	2	3	6	5.22	
Physical security vulnerability	Server damage	1	5	5	4.35	8.70
	Network damage	1	5	5	4.35	
Availability vulnerabilities	Physical disconnection	1	5	5	4.35	9.57
	Damaged services or DDOS	2	3	6	5.22	
Application security vulnerabilities	Insecure API	2	3	6	5.22	10.43
	SQL injection	2	3	6	5.22	
	Militias insider	1	5	5	4.35	
Personnel security vulnerability	IT staff unethical behaviour	3	1	3	2.61	12.17
	IT staff negligence	3	2	6	5.22	

Table 1 Vulnerability analysis in cloud computing environment (continued)

<i>Vulnerability category</i>	<i>Vulnerability type</i>	<i>Likely weight</i>	<i>Impact</i>	<i>Weighted score</i>	<i>Vulnerability (%)</i>	<i>Vulnerability category (%)</i>
Data protection vulnerability	Data loss or corruption	1	4	4	3.48	16.52
	Damaged backup tapes	1	1	1	0.87	
	Data replicated location is not secure	1	2	2	1.74	
	Data integrity is compromised	2	4	8	6.96	
	Data contamination occurred	1	4	4	3.48	
TCP/IP security vulnerabilities	Network eavesdropping	2	4	8	6.96	17.39
	Session hijack	1	4	4	3.48	
	Identity theft	2	4	8	6.96	
Mobile devices vulnerabilities	BYOD security breach	2	3	6	5.22	18.26
	Out-of-date application maintenance	3	2	6	5.22	
	Lack of comprehensive security services	3	3	9	7.83	

Figure 1 Histogram of business vulnerability categories



6 Conclusion

Cloud computing is here to stay. However, just like any other new technology platform, it comes with risks mainly due to information security and data loss. In this paper, business perspective of cloud computing has been reviewed with specific issues of different services in the cloud where vulnerability analysis associated with cloud management is accessed and explored with derived percentage representing cloud vulnerability. Collaboration and trust are highly essential between the business and their cloud providers in order to reduce such vulnerabilities. Businesses should be aware of possible risks of these threats and should plan for technical/managerial steps to try to avoid such threat. Ideally, businesses may adopt private cloud for their sensitive data and public cloud for their generic non-sensitive operation. The study conducted in this paper on cloud computing specific issues shows that mobility access and/or BYOD is currently the highest vulnerability score of 18.26% (Figure 1).

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Network competence based on resource-based view and resource dependence theory

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Abstract: The Resource-Based View (RBV) acknowledges that firms' resources contribute a lot to achieve competitive advantage. Therefore, it is critical to gain necessary resources to become more competitive relative to their competitors. Thus, network competence is the mechanism for firms to gain crucial resources. Based on Resource Dependence Theory (RDT), firms have to develop and maintain the relationships with their customers, suppliers and other relevant organisations to achieve important resources. By recognising the important role of network competence in achieving business success, this study aims to improve understanding of the concept of network competence and its relationship with the RBV and RDT, types of networking and their contributions towards small firms' business success. This paper concludes that network competence is an important organisational capability that leads towards competitive advantage and the firm's success. Thus, it is strongly recommended for firms to develop this competence to obtain critical resources for their businesses.

Keywords: network competence; RBV; resource-based view; RDT; resource dependence theory; networking.

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This paper is a revised and expanded version of a paper entitled 'Importance of network competence in achieving critical resources, competitive advantage and success for small firms' presented at 'SIBR 2015 Conference on Interdisciplinary Business and Economics Research', Bangkok, 4-6 June 2015.

1 Introduction

Network competence enables companies to establish a formal network with other companies, suppliers, customers and government agencies to get access to essential resources, knowledge and individuals. The research on network competence emerged in the 1930s and grew afterward (Jack, 2010). Firms developed more interest in developing their networks because they understood that it would be difficult to survive and grow as an isolated entity (Human and Naudé, 2009). Firms have to depend on interactions with other firms to get to know about a new market (Human and Naudé, 2009). Companies prefer to develop networks to get various resources and to avail themselves of business opportunities (Munksgaard and Medlin, 2014). Jack (2010) noted that extensive research has been carried out regarding the concept of networks; however, there are still some shortcomings as well as lack of understanding regarding networks. For instance, (i) there is inconsistency in the use of definitions of the term 'network' and analysis tools, (ii) very little or unclear evidence exists regarding knowledge accumulation through networks, and (iii) there is less evidence regarding interactions between networks and organisational outcomes. Small firms require different resources such as technology and access to information regarding customers' needs in order to succeed. The Resource-Based View (RBV) argues that firms' resources are essential for their business success. Both tangible and intangible resources are given importance in the existing literature (Runyan et al., 2006; Peteraf, 1993; Barney, 1991; Penrose, 1959). Intangible resources such as organisational competence and capabilities are the most crucial resources that are often rare, unique and valuable, but are helpful in achieving competitive advantage by the firms, whereas tangible resources including assets such as machinery, building, etc., are indeed important to run firm's businesses but are not rare among the rivals. As competitors can easily get tangible resources from the market, it is difficult for them to access the intangible resources, thus intangible resources are critical in getting the competitive advantage over rivals. Network competence is one of the most important intangible resources for the small firms' businesses. It is the organisational capability to develop and maintain long-term relationships with suppliers, customers and other relevant organisations to gain important resources because these parties have more

control over the firm's critical resources such as technology and other valuable information regarding emerging trends, and customers' preferences required to develop successful strategies for firms' business. A network constitutes a set of relationships with many other organisations such as suppliers, customers, competitors and universities that create a wider network structure (Cook and Emerson, 1978). From this aspect, firms are no longer considered as individual units that prefer transactional arrangements which are normally applied in traditional industrial organisation theory (Porter, 1987). Kale et al. (2000) focused on the quality of a network and suggested that a good balance between learning the critical capabilities and competencies from partners and protecting firm's key competencies actually leads to the development of respect, friendship and trust between network parties. Scholars have supported several theoretical viewpoints, for example resource-based theory (Barney, 1991; Wernerfelt, 1984), knowledge-based theory (Conner and Prahalad, 1996; Grant, 1996) and the dynamic capability perspective (Eisenhardt and Martin, 2000), to develop and improve understanding regarding capabilities that enable firms to be successful in dyadic network relationships (Anderson and Narus, 1990; Dyer and Singh, 1998), joint ventures (Merchant and Schendel, 2000; Reuer and Koza, 2000), strategic alliances (Anand and Khanna, 2000; Kale et al., 2002), and industry networks (Dyer and Nobeoka, 2000; Gulati, 1998). This paper will thus highlight the concept of network competence, and will attempt to link theories such as the RBV and Resource Dependence Theory (RDT) with network competence. It will also highlight the importance of network competence in gaining competitive advantage, its impact on firms' performance, and its importance in the field of entrepreneurship. It will also discuss the types of networks and their importance, as well as the importance of network competence in gaining superior firm's performance in the international markets.

2 Concept of network and network competence

The concept of network refers to the relationship between the employees and the management team of a firm with suppliers, customers, bankers, distributors, competitors, government agencies, friends, families or any other entity that is able to provide critical resources for the success of a firm both at local and international markets (Zain and Ng, 2006). Firms build different types of networks with different entities to achieve strategic goals through collaboration (Möller and Halinen, 1999; O'Donnell et al., 2001; Nerys and Esyllt, 2004). According to Iacobucci and Zerrillo (1996), research on networks focuses on understanding the interconnections between different units. Because of this it is considered very important in the literature because networks comprise a medium through which small businesses can increase their essential resources (Iacobucci and Zerrillo, 1996). Networks play an important role for the success of SMEs because they enable SMEs to access new markets and provide them various business opportunities that lead to profitable businesses (Street and Cameron, 2007). Therefore, it is essential to understand the outcomes of having different networks or external relationships with various parties and how they impact the performance of firms. Hence, the significant outcomes of networks act as a primary motivation for SMEs to participate in a network (Street and Cameron, 2007). On the other hand, network competence is defined as the firm's ability to develop and manage relations with their suppliers, customers, and other organisations, and to deal effectively with the interactions among these relationships (Ritter et al., 2002; Ritter, 1999). Firms' abilities to develop networks are a potential

source of superior performance and sustainable competitive advantage (Ziggers and Henseler, 2009; Dyer and Singh, 1998). Network competence is defined in various ways. Some consider it as a dyadic ability between partners, while others take into account the existence of various partners in a set of networked relationships. They are often defined as either capabilities or competences. However, in practice, the terms capability and competence are used interchangeably in the research literature (Zerbini et al., 2007; Ritter, 2006). Network competence is a core competence and is also one of the developed relational abilities of an organisation (Ritter et al., 2002).

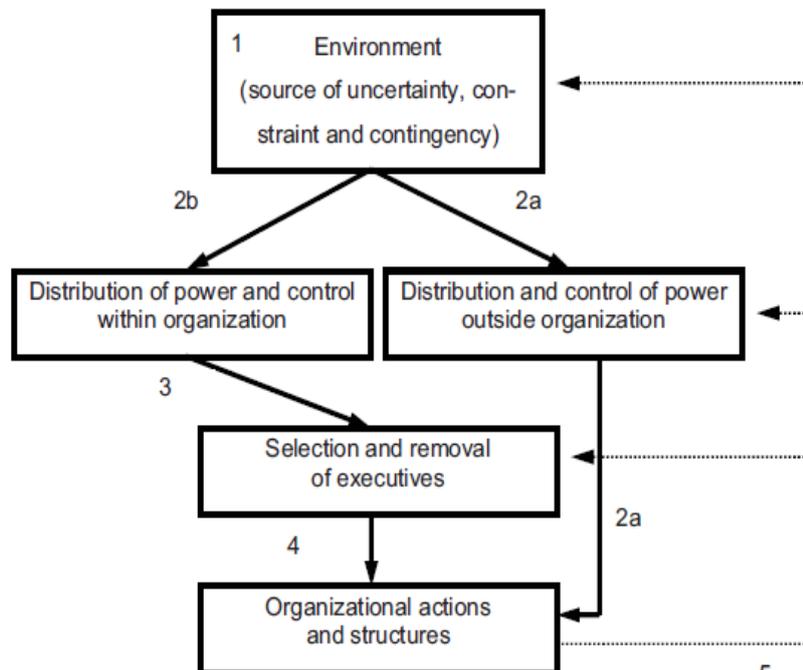
3 Network competence, resource dependence theory, and resource-based view

Several theories have been used to explain the network competence (NC) of a firm. However, in this study we will consider two theories, namely the RBV and RDT. Firstly, NC will be explained on the basis of RDT as follows.

3.1 Basic ideas in resource dependence theory (RDT)

The basic ideas represented by RDT are shown in Figure 1 which was adapted by Nienhüser (2008) from the original diagram by Pfeffer and Salancik (1978) to depict RDT more clearly.

Figure 1 The association between environment, organisation and organisational actions



Source: Nienhüser (2008, p.11)

(1) Environment as a source of uncertainty and constraint

According to Pfeffer and Salancik (2003), in order to understand the behaviour of any organisation, it is essential to understand the context of that behaviour which is the 'ecology of the organization'. They also criticised that the theories focusing on the internal process of resources always usually ignore the processes regarding gaining these resources. They postulated that the environment provides 'critical' resources required by the organisation. Thus, the organisation must identify its critical resources. The criticality measures the organisation's ability to perform functions in the absence of the resource or in an absence of the market for the output. A specific resource may only be a very small part of total resource needs, but its absence may impact badly on the organisation's performance (Pfeffer and Salancik, 2003). However, according to Nienhüser (2008), RDT does not argue that the critical resource dependence and the environment directly impact organisational behaviour. But it is based on assumptions about actors and their relationships with the environment. Such relationships help organisations to reduce uncertainty. The uncertainty refers to the extent to which one cannot anticipate and accurately predict the future world's states (Pfeffer and Salancik, 2003). The environment is the main source of uncertainty. The degree of uncertainty varies and depends on the distribution or availability of critical resources in the environment. Pfeffer and Salancik (2003) have interpreted uncertainty that causes scarcity of critical resources and their low concentration in a way of action theory. According to this action theory, some actors control resources and other actors need these resources which lead towards relationships of dependency. If one organisation possesses the reserve of resources, this reduces its dependency on other actors. The concentration of resources means the concentration of power. On the other hand, fewer resources result in a higher concentration of power in the environment that will cause many connections between actors (i.e. complexity), the interdependencies may arise and the amount of uncertainty can become higher that needs to be minimised. The only uncertainty is not a problem but when there is dependence on critical resources and uncertainty as well, then the organisation has to take measures to minimise the uncertainty.

(2) Environment and distribution of power

According to Nienhüser (2008), one main hypothesis in RDT is that whoever controls the critical resources has more power over other organisations that need these resources. Pfeffer and Salancik (2003) referred this hypothesis to exchange theory (Jacobs, 1974; Blau, 1964) and the power dependency theory by Emerson (1962), where the Emerson (1962) theory has a few statements: (a) greater the dependency of organisation A upon another organization B, more power of organisation B will have over A; and (b) the dependence of the organisation A upon organisation B is directly proportional to A's amount of motivational investments in objectives and goals mediated by B but inversely proportional to the availability of these goals to A outside the A-B relation (Emerson, 1962). Also, it is assumed that organisations want to minimise their dependence upon others. For this, they try to reduce their needs. Secondly, they can seek alternative resources. They can more reduce their dependence on other organisations if their control resources become more important for other organisations on which they depend on. Pfeffer and Salancik (2003) have applied these basic assumptions to the behaviour of the organisations that the organisations will be impacted by other organisations that have control of their critical resources (Pfeffer and Salancik, 2003). The authors have

expanded the assumptions of Emerson in two ways: firstly, they took the idea of bounded rationality seriously and considered that external demands are not always recognised upon the organisation and that demanding organisations deal with the difficulty to judge regarding which extent their demands have been met. Thus, the variable 'perception' is very important for organisational behaviour. Secondly, they emphasised that an exchange relationship cannot be minimised by just involving two organisations because the relationships among several organisations have to be considered. Pfeffer and Salancik (2003) have also applied the idea of exchange to the exchange relationships within the organisations well, where both individuals and departments exchange the resources. And depending on their control of resources, they have more or less power and can impact decisions according to their interests.

(2a) External distribution of power and the management of dependency relationships

The organisation that has more control over a large part of critical resources but does not need any resource from other organisations is more powerful and can make and may reveal high demands on the organisations that depend on it for resource acquisition. Thus, the more dependency of an organisation on other organisation leads to the higher amount of uncertainty. So it will try more to reduce uncertainties. This shows the importance of management. However, the behaviour of management is not completely determined by the environment. Pfeffer and Salancik (2003) did not see the management as an actor to maximise profit or to realise rational strategies. Management is very important for the organisation regarding resource acquisition. For instance, if the manager of a company does very well then he can win the trust of shareholders who will provide resources in return. Managers make decisions according to the conditions of external environment and also that benefit the shareholders. They adopt various strategies to face the uncertainty in external and internal environments. For example, they may decide for vertical integration to control over own resources or horizontal integration to dominate the resource controllers. With these strategies, they may minimise the uncertainty in the external environment, whereas, to reduce the uncertainty in internal environments, they may develop strategies towards the board of directors and other members of influential organisations. For instance, boards of directors and financial organisations assist to deal with financial uncertainty. Thus, organisations compose boards to acquire critical resources needed for the survival of the organisation.

(2b) Internal distribution of power

Stakeholders cannot necessarily to be found outside the organisation, because the actors or departments within the organisation also have control over important resources as well. RDT also hypothesised that the sub-units within the organisation that face critical problems of the organisations acquire power in it. For example, if firms are influenced by various changes in the law then their internal legal departments become more powerful. Similarly, if the demand of the product is unstable and has to make frequent changes in the product, then it is probable that the technical and marketing department become more powerful. If any change occurs in the environment, then the dominant sub-unit will seek any information to minimise the uncertainty that might occur because of their relevant segments.

(3) The connection between distribution of power and executive succession

Organisations plan executive succession to maintain the power in uncertain situations. Those who have more power will select someone to fill a position to whom they think capable to maintain and improve their power. Because of the psychological effect the people will prefer people having similar backgrounds to them, for example marketing specialists will prefer marketing specialists and lawyers will prefer lawyers. Such attempts to maintain the power within the organisation actually contribute towards the organisation's survival in uncertain conditions of the environment.

(4 and 2b) The connection between management structure, distribution of power, and decisions of organisational structures

Because of control over resources, external stakeholders impact the filling of important positions with the organisation's structure. Management is more powerful in decisions regarding the efficiency of the organisations. This is a means to retain power within the organisation. The actions of management meet the demands of the important suppliers of critical resources that also contribute towards access to important resources as well as to ensure the survival of the organisation.

For this present study, the insights from RDT are considered in the network competence of SMEs to minimise uncertainty in turbulent environments by establishing relationships with the main suppliers and customers of critical resources that are needed for the SMEs operations. RDT is a very useful approach in explaining the acquisition of resources from the external environment by developing vertical and horizontal integration with the external parties.

3.2 Network competence (NC) in relation to resource dependence theory (RDT)

According to Nienhüser (2008), the concept of the 'Resource Dependence Perspective' (1978) achieved public awareness through a book by Pfeffer and Salancik titled as 'The External Control of Organisations: A Resource Dependence Perspective' and then was widely accepted in the Anglo-American discussion. A basic assumption of RDT is that dependence on important or critical resources impacts the actions of organisations and that the decisions of organisation and its actions can be explained through a particular dependency situation (Nienhüser, 2008).

RDT is regarded as one of the most influential theories in strategic management and organisational theory (Hillman et al., 2009). This theory characterises the organisation as an open system that depends on various contingencies in its external environment (Pfeffer and Salancik, 1978). According to Pfeffer and Salancik (1978), RDT recognises the impact of external factors on behaviour of the organisations and managers can act to reduce the uncertainty and dependence of such factors in the external environment of their organisations. Such external factors exert their power on the organisations that could impact their success and growth as well. Therefore, organisations strive to reduce the power of external factors over them and attempt to increase their power over others (Hillman et al., 2009).

RDT has been used as a primary theoretical perspective in understanding various relationships such as joint ventures, and many other inter-organisational relationships that include: buyer-supplier relationships, strategic alliances, R&D agreements, joint-marketing agreements (Barringer and Harrison, 2000; Oliver, 1990), and in study of

mergers where RDT perspective explores how mergers assist organisations in resource acquisition to reduce interdependence and uncertainty (Harrigan and Newman, 1990; Pfeffer and Salancik, 1978). Several empirical studies support this perspective that resources can be gained and complexity in domestic and international environments can be reduced by using inter-organisational relationships (Elg, 2000; Goes and Park, 1997). The inter-organisational relationships are usually developed between domestic or international buyers and suppliers (Provan and Gassenheimer, 1994).

The origin of RDT is in social exchange theory. RDT focuses on the needs of firm's resources (Chiu, 2008). Thus, the firms seek to build relationships with other firms to gain to access the needed resources and assets (Pfeffer and Salancik, 1978; Nohria and Garcia-Pont, 1991). Traditionally, firms more depend on their vertical network members but now increasingly establish relationships with their horizontal actors to acquire resources (Chiu, 2008). Thus, RDT is concerned with firm's requirements to gain resources from other actors in its environment and states how scarcities of firm's resources force it to introduce new innovations that utilise alternative resources (Sherer and Lee, 2002; Salancik and Pfeffer, 1978).

Scholars generally integrate RDT with network or networking theory, which is also based on many common assumptions regarding dependence but more emphasises on the socially embedded context of organisations (Hillman et al., 2009). Others have integrated RDT with organisational learning and game theory to understand the power of partners (Saxton, 1997), with network theory or transaction cost to predict their choice of partners (Elg, 2000; Steensma et al., 2000) and with the RBV to model the partner integrations (Murray et al., 2005).

Inter-organisational relationships are very useful for organisations specifically in turbulent environments. For example, Gulati and Sytch (2007) found that the joint dependence of organisations with their partners can reduce uncertainty and improve their performances. The authors also found that organisations can use a network of inter-organisational relationships to access power and resources (Lomi and Pattison, 2006; Bae and Gargiulo, 2004). Thus, Hillman et al. (2009) suggested that RDT theory has improved the understanding of network considerations and interdependence regarding intra-organisational relationships. According to Hillman et al. (2009), by integrating RDT with other theoretical perspectives can consider the dynamic nature of dependencies and power between the organisations with others. This view supported Pfeffer and Salancik's (1978) assertion that organisations that are dependent on the environment can minimise environmental contingencies by establishing and implementing multiple strategies. Hillman et al. (2009) stated that mergers and acquisitions, joint ventures and other inter-organisational relationships such as executive succession, boards of directors, and corporate political action are used to manage such dependencies.

Thus, RDT is concerned with the firm's requirements to gain resources from other actors in its environment and states how scarcities of firm's resources force it to introduce new innovations that utilise alternative resources (Sherer and Lee, 2002; Salancik and Pfeffer, 1978). In other words, the SMEs have to depend on their suppliers as well as customers in order to get needed resources such as quality raw material, technology, emerging trends and information regarding current tastes and demands of customers. Thus, based on RDT, this paper argues that the SMEs have to develop and maintain long-term relationships with their suppliers and customers and all other interested parties to achieve the required resources which are critical for their survival and success.

3.3 *Basic ideas in the resource-based view (RBV)*

Although the RBV is the more dominant view in strategic management (Newbert, 2007; Acedo et al., 2006), it has had an impact on a number of other fields in management research, such as international management, technology management, HR management, and organisation theory (Foss, 2011; Runyan et al., 2006). However, there is little doubt regarding its influence on managerial practice, mainly through relevant ideas on core competencies, capabilities, and so on. The RBV constitutes a broad set of ideas. For instance, some use the RBV in a narrow sense regarding mainstream economics about the necessary conditions for sustainable competitive advantage, whereas others use the RBV in more broadly sense to represent firm performance to firm 'resources', based on ideas such as 'dynamic capabilities', 'core competencies' and 'capabilities' that highlight heterodox ideas in economics, cognitive science insights and sociology (Foss, 2011). The RBV focuses on the generation of competitive advantages from the unique set of resources by the firms (Peteraf, 1993; Barney, 1991; Wernerfelt, 1984). Thus, understanding the sources for achieving firm's sustainable competitive advantage has become an important research area in the strategic management field (Barney, 1991; Grant, 1991; Wernerfelt, 1984). Most of the researches regarding sources of sustainable competitive advantage usually emphasised either on the threats and opportunities of the firms or just described their weaknesses and strengths (Porter, 1980), or analysed how these could be matched to develop and choose strategies (Hofer and Schendel, 1978; Penrose, 1959). However, it is evident that the RBV approach is useful in improving our understanding regarding the impact of a firm's environment on business growth (Barney, 1991).

According to Barney (1991), the RBV is based on two basic assumptions in studying a firm's internal weaknesses and strengths. First, based on Penrose (1959) work, it assumes that firms have bundles of productive resources and that these firms vary in possessing different bundles of such resources. This is also known as the assumption of the firm resource heterogeneity. On the other hand, a second assumption is based on the work of Selznick (1957) and Ricardo (1966) that some of the firm's resources are either inelastic in supply or very costly to copy. This is known as the assumption of resource immobility. One of the important characteristics of the RBV is its focus on the firm's internal forces and factors (Ferreira et al., 2011). This approach is traced back with the pioneer work of Penrose (1959). From last few decades, the firm resources are given more importance for the formulation of its strategy. This interest was due to some dissatisfaction with the static framework of industrial economics with only focus on the relationship between the external environment and strategy (Grant, 1991).

Several improvements took place on different strategic levels that contributed to the concept of the RBV (Ferreira et al., 2011). Basically, the RBV describes a firm in terms of the resources that it integrates. Penrose (1959) highlighted the condition of a firm as a group of resources not just a unit. Frequently, the term resource indicates those attributes that improve effectiveness and efficiency of the firm (Wernerfelt, 1984). Miller and Shamsie (1996) stated that resources should have some capability to avoid losses or to generate profits. Thus, a general availability of resources will neutralise the competitive advantage of the firm. In order to achieve the high levels of firm's performance with a sustainable competitive advantage, it requires acquiring heterogeneous resources that would be difficult to create, to substitute or to imitate by other firms.

Thus, the firms have diversity of resources that can be classified it into various categories, for example intangible and tangible resources (Penrose, 1959), strategic resources (Day, 1994; Day and Wensley, 1988), assets (Day, 1994; Barney, 1991), and capabilities (Day, 1994; Barney, 1991).

Intangible resources and tangible resources have been given more attention. Intangible resources include knowledge, skills, reputation and entrepreneurial orientation. Tangible resources consist of capital, access to capital and location (Runyan et al., 2006). Therefore, the main reason for firms' success and growth can be found inside the firms; for instance, firms' internal resources will lead towards the sustainable competitive advantage (Peteraf, 1993). According to some authors, resources are insufficient for achieving a sustainable competitive advantage as well as high performance (Day, 1994; Chandler and Hanks, 1994; Barney, 1991; Grant, 1991). According to them, firms can achieve competitive advantage only when they transform their resources into capabilities that will result into high performance (Mahoney and Pandian, 1992). According to Penrose (1959), a firm shows superior performance not because of better or more resources but also because of its distinctive competence (activities that a firm does better than its rival firms) that allows the firm to use its resources in better or most effective ways.

Barney's (1991) RBV of the firm, affected by Penrose, described that tangible and intangible resources are the main components of the firm's competitive advantage. According to Barney (1991), the firm's resources must be assessed with regard to their rarity, value, accessibility, or its competitor's ability to copy. Basically, the RBV model consists of three major components, namely tangible, intangible and organisational capabilities of the firms. Tangible resources constitute the firm's financial, physical, organisational or technological assets. Intangible resources are not easy to imitate and quantify. They are referred to human resources, reputation, innovation and creativity of the firm.

The concept of capabilities refers to a group of individual qualifications, accumulated knowledge and assets, exercised through organisational processes to coordinate and use resources in a better way (Day, 1994). There is a basic distinction between capabilities and resources. A capability is a capacity to perform any task or activity for a team of resources. While the resources are the source for the firm's capabilities, and, thus, the capabilities are the key sources of firm's competitive advantage.

Organisational capabilities mean the competencies and skills that a firm utilises to deploy intangible and tangible resources. However, only the possession of a capability or a resource does not lead to a firm's competitive advantage, because, in order to achieve competitive advantage, the capability or resource must either be rare, valuable, difficult to substitute, or difficult to imitate.

3.4 Network competence in relation to the RBV

The concept of network competencies is derived from the firm's RBV which is a key pillar in the literature of strategic management (Barney, 1991). A firm's competencies or resources refer to all capabilities, assets, knowledge and processes that reside in the firm (Amit and Schoemaker, 1993; Peteraf, 1993). Barney and Arian (2001) highlighted the basic assumption of the RBV of competitive advantage that a firm controls its important strategic resources in different ways from other firms, and such key resources are not perfectly mobile between firms. The RBV suggests that the aim of any strategy is to

improve the value creation capability of firm resources (Reed and DeFillippi, 1990; Wernerfelt, 1984). The resource characteristics are main conditions to enhance the potential for firm's value creation (Barney, 1991). Sustainable competitive advantage can be achieved by meeting these positive conditions. According to Barney (1991), the four conditions should be met by the resources that can lead to competitive advantage, namely rare, valuable, imperfectly substitutable and imperfectly imitable. These four conditions are considered desirable when overall resource profile (i.e. combination of resources) of a firm meet them, as the network competence of a firm refers to its ability to handle network relationships with key parties and improve its network status (Jian and Wang, 2013). Some researchers have focused on firm's network settings and network positions (Hagedoorn, 2006), the management of network relationships with external parties (Ritter, 1999), and also both of these two aspects (Ritter, 1999; Ritter and Gemünden, 2004). Arguably, the performance of an organisation largely depends on those parties with whom it interacts (Jian and Wang, 2013). We therefore argue that the firm's ability to establish and manage relationships with main customers, suppliers and other organisations and its effectively dealing of such relationships is a firm's core competence that represents its performance and competitive strength, which is the firm's network competence. The firm's value creation is derived and grown from its network relationships with external parties (Dyer and Singh, 1998) and such firm's value is effected by alliance activities (Anand and Khanna, 2000; Kale et al., 2002).

4 Importance of network competence

The firms cannot be successful through their individual efforts alone because their performance is contingent upon the activities, performances and quality of relationships with other counterparts as well (Wilkinson and Young, 2002). Such relationships with external parties constitute both competitive and cooperative elements. Simultaneously, the firms expand their resources through cooperation and they compete to get the means of such resources. The firms compete to establish cooperative relationships with their counterparts such as suppliers and customers to create competitive advantages by creating value for the consumers (Wilkinson and Young, 2002). Such rivalry to build the relationships reorganises the networks of relations among firms, and then ineffective exchange relationships and inefficient firms are driven out, which improves the firm's efficiency and effectiveness by sorting out losers and winners counterparts (Johanson and Mattsson, 1994). The network relationships require substantial investments in money, time and effort, thus they are providing the means to acquire and create the knowledge and other critical resources (Wilkinson and Young, 2002).

Furthermore, such relationships result into interdependent relations that are referred to as business networks (Anderson et al., 1994). Just as the behaviour of a firm and its performance depends on other firm's behaviours and performances, similarly the performance and behaviours in a focal dyad depend on other relationships (Holm et al., 1996). Thus, coordination between these relationships becomes an important managerial concern to improve the joint productivity of value system. Such network interdependencies create problems for an individual firm in formulating and implementing its marketing strategies, because all actors in a network strive to attain their own goals while considering the responses and effect of other actors as well. Over time, the firms in a network relationship have learned about the behaviour of others through their

interaction and then modify their network theories and behaviours accordingly. Thus, the network competence of firms makes them more successful by forcing their rival individual firms to quit their businesses and, therefore, in low intense competitive business environment due to few competitors, network competence may lead towards sustainable competitive advantage of small firms.

5 Impact of network on firm's performance

Firms are recognised as embedded in networks constituting professional relationships with other network actors (Håkansson and Snehota, 1989; Granovetter, 1985; Gulati and Gargiulo, 1999), including customers, suppliers, and strategic allies (Walter et al., 2006; Achrol, 1997). Some studies have illustrated the positive impact of network competence on innovation performance (Chiu, 2008; Ritter and Gemünden, 2004). Similarly, Parida et al. (2012) found a positive linkage of network competence to entrepreneurial orientation and small firm's performance. Watson (2007) examined the relationship between firm performance and networking of established SMEs in Australia and found a positive relationship of formal as well as informal networking with firm survival but found the association of only formal networks with firm's growth. However, the role of network competence in the firm's strategy is not explored in different contexts. Many researchers have called to clarify its impact in processes related to survival and growth (Ritter and Gemünden 2003; Ritter et al., 2002). Network competence has been used as a moderator in many studies. For instance, many studies have found the moderating role of network competence between the relationships of entrepreneurial orientation and performance of organisation (Zhang and Zhang, 2012; Stam and Elfring, 2008; Walter et al., 2006).

It is observed that most of the research has linked network competence with the firm's survival, success, growth, and superior business performance; therefore, there is indeed truly a need to develop network competence by firms.

6 Networking and competitive advantage

The success of businesses highly depends on their abilities to achieve and then sustain competitive advantage. It is crucial for all businesses to develop certain strategies in order to take the competitive edge over their rivals. Businesses can achieve the competitive advantage by providing unique, new, rare and different products and services according to the needs of their customers. Therefore, firms must know the current trends of the market, their customers' needs and ways to achieve the critical resources. Firms will lose businesses if they are unable to meet their customer's needs and demands. Thus, in order to get useful information regarding markets, products, services and customer's needs, the firms have to use their networks. Networking with other parties such as customers, suppliers and government agencies provides useful resources in terms of information for the firms to develop their new, unique and differentiated products in order to achieve competitive advantage in the markets. Thus, it would be better to say that networking is considered as a main source of competitive advantage (Wilkinson and Young, 2002; Dyer and Singh, 1998). Networks represent different actors linked with each other by a set of social relationships that vary in depth and scope of such

relationship contents (Hakansson and Ford, 2002). Industrial networks constitute independent firms that coordinate their resources and activities and work collaboratively to achieve common goals. Such relationships can be vertical as well as horizontal which connect the companies to their suppliers, competitors, customers or other entities (Gulati et al., 2002). Therefore, firms are required to increase their networking with the relevant parties in their external business environment to get the competitive advantage over competitors. By utilising networks, firms can learn about the best practices of their rival firms in providing quality products and services. Having information regarding competitors, the firms can then develop new ideas and formulate their own strategies to the market.

7 Importance of network competence in entrepreneurship

Entrepreneurs have to deal with various risks and innovative tasks. Thus, they highly depend on resources to fulfil their innovative goals. Resources can be in various forms such as knowledge, expertise, information and other assets. Entrepreneurs fail to do their businesses if they cannot implement successful strategies. In order to develop such business strategies, firms seek various types of resources. Thus, they interact with their customers, suppliers and competitors to update themselves about the latest trends in the market. Several authors have mentioned the importance of networks impacting entrepreneurial process (Hoang and Antoncic, 2003). According to entrepreneurship theory, the ability to detect, exploit and willingness to pursue the opportunity in the marketplace are the essence of entrepreneurship (Stevenson and Jarillo, 1990; Shane and Venkataraman, 2000; Oviatt and McDougall, 2005). However, not all entrepreneurs have such abilities and sufficient resources to access the opportunities. Therefore, they need to collaborate with other economic actors to gain access to markets and resources (Zain and Ng, 2006). Thus, they have to develop networks in order to exploit new opportunities, learn from experiences, obtain knowledge and access resources (Chetty and Holm, 2000). Therefore, Dubini and Aldrich (1991) considered entrepreneurship as a networking activity. Networking is one of the most powerful assets to access power, knowledge, information, capital and technologies (Elfring and Hulsink, 2003; Inkpen and Tsang, 2005).

Networking is considered as one of the potential sources of a firm's competitive advantage because of its numerous advantages (Chiu, 2008; Andreosso-O'Callaghan and Lenihan, 2008; Ritter and Gemünden, 2004). For instance, the network competence of firms leads in developing effective international strategies that result into their sustainable competitive advantage (Ziggers and Henseler, 2009; Dyer and Singh, 1998). Several researchers have investigated the relationship between networking and firm performance. For instance, according to Gulati et al. (2002), the firm's performance can be fully understood by examining its network relationships. Networking or network relationships lead to superior firm performance (Andreosso-O'Callaghan and Lenihan, 2008; Ritter and Gemünden, 2004). Network competence is one of the core competences and the firm's developed relational abilities (Ritter et al., 2002). Previous studies found that networks help the small firms in accessing difficult to imitate resources (Yli-Renko et al., 2001), in achieving innovativeness (Ahuja, 2000; Baum et al., 2000), in achieving superior performance, survival and growth by assisting firms to enter faster in new markets (Lee et al., 2001; Walter et al., 2006). From the above evidence, it can be

concluded that network competence is very important for entrepreneurial firms to develop as it leads towards success and competitive advantage through different network ties.

8 Types of networks and their importance

Networks can be differentiated into two broad categories on the basis of the nature and source of the relationships which are: (1) informal networks (Shaw, 2006) and (2) organisational networks (Premaratne, 2001) or business networks (Wright and Dana, 2003). The former indicates informal relationships with the friends, relatives, and acquaintances. The latter refers to relationships with actors that control the activities of business such as distributors, customers, suppliers, government, and competitors. The literature has highlighted the importance of personal networks. For instance, personal networks provide useful advice and more stable flow of information to small firms (Premaratne, 2001). However, importance to different networks varies according to different contexts or countries. For instance, Shaw (2006) found that small firms in Scotland depend more on informal rather than formal networks to get advice and information.

Firms can build networks with various parties in their business or organisation networks, namely network relationships with downstream partners (customers), upstream partners (suppliers) and horizontal partners (competitors). The network relationships with upstream partners usually involve direct suppliers, more important for small firms and new ventures as they assist in the development of more efficient processes. Such network relationships with suppliers impact positively on quality, cost, technology and efficiency of firm's production processes (Ragatz et al., 1997). Lee et al. (2001) stated that close relationship with the established suppliers would increase small firms' and new ventures' credibility among their customers and other relevant parties. Through suppliers, the firms can access the entrepreneurial opportunities through their stronger position in the market (Parida et al., 2010). Arend (2006) found networking with upstream parties positively impact the organisational performance. Network relations with downstream partners involve direct customers. By understanding the expectations and needs of customers, a firm can succeed in the market (Jacob et al., 2006). Downstream networks can drive the innovativeness of a firm (Gemünden et al., 1996). Close interaction with main business customers allow firms to learn about their needs in existing market as well as lead discovering the future needs prior to their competitors (Von Hippel, 2007). Networking with horizontal partners mainly involves those organisations and firms which are involved in external parties of a firm's value chain, for example universities, competitors, and government agencies. Compared to developing network relationships with vertical partners, the networking with horizontal partners is initiated more carefully (Parida et al., 2010). Teng (2007) highlighted that collaboration with other firms serves as an alternative for resource acquisition as well because of its flexible arrangement that can also share risks and costs. The firms can get higher performance by sharing knowledge, the cost of development, and joint procurement with competing firms (Pittaway et al., 2004). Networking with government agencies and universities is pivotal for firms as well; for instance, networking with institutions of government may assist firms to develop legitimacy and can lead firms towards their opportunistic behaviour with lower risks, and, similarly, a university can serve as a prospective partner to access to

technologies and novel knowledge (Etzkowitz and Leydesdorff, 2000). Therefore, firms have to understand different types of business networks and their importance in achieving valuable and critical resources needed for their successful businesses.

9 Network competence and performance in foreign markets

Firms seek to expand their businesses in overseas markets after gaining success in local markets. It is essential for the long-run success of businesses to explore new opportunities and expand their businesses in international markets. Like the important role of networks within local markets, businesses cannot ignore their importance while entering foreign markets. If firms have existing contacts or networks in foreign markets, it would be easy and convenient for them to cope up various challenges such as cultures, market information, and trends. By using their networks, firms will be better in a position to explore new opportunities in other countries. Networks enable them to reduce the uncertainties in their business environment. In today's global and modern social era, networking is crucial to face intensified global competition and to meet major challenges in businesses of developing countries. Network competence enables service exporters to increase their share of foreign markets at less cost and risks, achieve productivity gains and improve their profitability (Musteen et al., 2013). Networking helps in expansion of small- to medium-sized enterprise (SMEs) of many developing countries (Ngoma and Ntale, 2014). Some researchers have mentioned the advantages of utilising network relationships. For example, Watson (2007) suggested that network relationships enable SMEs to get all those resources that they do not possess. Andreosso-O'Callaghan and Lenihan (2008) have discussed the contribution of networks in exchanging knowledge and minimising transaction cost that ultimately lead to superior performance. Networks play a vital role for achieving efficiency in business operation under globalisation (Möller and Halinen, 1999). Many other studies have indicated that firms can avail the opportunity to perform in foreign markets through their abilities of managing their business relationships (Torkkeli et al., 2012; Hanna and Walsh, 2008; Mort and Weerawardena, 2006; Coviello and Munro, 1997; Bell, 1995). With scarce resources, knowledge and limited access to foreign markets, the participation of SMEs in international business highly depends upon their networks or relationship with a large number of market intermediaries (Zain and Ng, 2006; Wright and Dana, 2003). Such networks facilitate their internationalisation in the shorter time and with lower cost to enter foreign markets relative to companies with few business relationships (Coviello and Munro, 1997; Sjöholm, 2003). In the context of Malaysia, the business networks are essential for SMEs success as well. For instance, Zain and Ng (2006) found that business networks create confidence, trust, and credibility of Malaysian SMEs in foreign markets. Thus, in order to expand businesses in foreign markets, small firms have to expand their network relationships with suppliers and other relevant organisations. Such network relationships will not only assist local firms to enter in international markets but also be helpful in providing valuable resources required by them to operate in international markets.

10 Discussion and conclusion

This paper has attempted to discuss the importance of network competence for the firms' success. RBV argues that organisational resources are the major source of competitive advantage for any firm. As the small firms have insufficient critical resources for their business operations, RDT argues that firms have to develop and maintain their good relationships with external parties in their business environment which usually include suppliers, buyers, and other relevant organisations. Close relationships with these parties enable the firms to get the critical resources for their businesses. For example, firms can get the good material at reasonable prices from their suppliers. Similarly, good relationships with buyers can provide valuable information regarding buyer's preferences, tastes, needs, wants, etc. Also, research organisations such as universities are a vital source of getting information regarding handling problems, competitors' actions, industry trends, consumer behaviour, etc. Thus, a firm will be able to utilise its resources when it will have access to critical resources. And to access the important resources, firms need to develop their network competence. Network competences will not only assist firms in achieving competitive advantage in their local markets but research is also evident regarding the important role of firms' network competence in expanding businesses in international markets. Strong network ties with the suppliers, customers, and other organisations make easy to achieve goals in international markets. On the other hand, a firm without having any network relationships with its suppliers and customers cannot face the turbulent business environment which is normally characterised with the unexpected changes in the competitors' actions, changes in technology and consumers' preferences. Therefore, survival of such firms is not possible in the long run due to lack of network competence. Only firms with network competence are able to survive and succeed in long run in any kind of uncertain environment because the resources they get through their networks enable them to develop and execute successful strategies to face the environmental threats. Entrepreneurial activities are linked with networking as well. For instance, Dubini and Aldrich (1991) considered entrepreneurship as a networking activity. The network is a major source in accessing towards power, knowledge, information, capital and technologies (Elfring and Hulsink, 2003; Inkpen and Tsang, 2005). Andreosso-O'Callaghan and Lenihan (2008) have stated the contribution of networks in exchanging knowledge and minimising transaction cost that ultimately lead to superior performance. Networks play a vital role in achieving efficiency in this globalisation era (Möller and Halinen, 1999). The participation of SMEs in international business highly depends upon their networks or relationships with a large number of market intermediaries (Zain and Ng, 2006; Wright and Dana, 2003). Therefore, networking is considered as one of the vital sources of a firm's competitive advantage because of its various benefits (Chiu, 2008; Andreosso-O'Callaghan and Lenihan, 2008; Ritter and Gemünden, 2004).

From the above discussion, it can be concluded that network relationships play a significant role in the success of firms in both domestic and international markets, especially under globalisation, which is characterised with more challenges and opportunities. Thus, managing both formal and informal network relationships effectively serves as a source of competitive advantage that leads to the firm's superior performance.

11 Study significance, limitations, and future recommendations

This study is useful in many ways. For example, it has provided useful insights regarding the importance of network competence for the success of businesses. The theories and concepts have highlighted the necessity of network competence. Businesses should focus on building this competence in order to get critical business resources. Government agencies can develop many programs and training sessions for business owners regarding the development of network competence. Thus, this study has added into the knowledge of researchers and businessmen that how network competence can be useful for the growth and success of their businesses. By developing and improving the relationships with stakeholders, businesses can not only get essential resources but can also minimise the uncertainty in their external environment. Network competence is a mechanism that actually facilitates the growth of businesses in local as well as in international markets.

Although this study has highlighted the importance of network competence, there are some limitations of this study as well, for instance: (i) this study is based only on theoretical concepts and lacks empirical evidence regarding the impact of network competence on business performance; (ii) it seems to be unclear that how the importance of network competence can be explained by RBV and RDT; and (iii) the study did not take into account that what strategies should be implemented to build network competence.

In order to overcome flaws of this study, we recommend some further studies in this regard. For example, (i) future studies should focus more on empirical evidence regarding the impacts of network competence on firms' performances; (ii) there is a need to deeply investigate the components of network competence; (iii) it would be interesting to investigate the strategies to build this competence by the firms; (iv) in the context of Malaysia, this study highly recommends to empirically explore the role of network competence for the success of SMEs; (v) a comparative study can be conducted across various cultural groups within Malaysia to investigate the importance of network competence in the survival, success and growth of businesses; (vi) there should be a series of continue studies to investigate how firms can achieve sustainable competitive advantage due to their network competence; (vii) future studies should investigate that what kind of difficulties or obstacles can be faced by various businesses while developing network competence in local as well as international markets; and (viii) the role of government is needed to be highlighted in the development of this competence.

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Mining economist opinions on using multi-agent methodology to simulate metal markets

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Abstract: In coming years, distortions on metal markets are likely to appear. Indeed, some countries control most of the production of certain categories of metals and could implement exportation quotas. Consequently, consuming countries like France face increasing risks of shortages of some metals. In response, the French government suggests that a set of prospective tools be implemented, including a prospective simulation tool based on a multi-agent system (MAS) approach. The goal of this paper is to report and discuss critiques by mining economists on the value and abilities of MAS to simulate critical metal markets whenever the approach is appropriate. The motivation is: (a) to define the gaps currently existing between MAS and mining; (b) to provide indicators on how MAS approach should be enhanced to reduce these gaps; and (c) to produce an improved initial metal classification that is suitable for such a modelling exercise.

Keywords: critical metal markets; multi-agent methodology; prospective simulation; mining economist critiques.

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1 Introduction

In coming years, the growing demand for industrialisation processes and progress in technologies means that mining economists will expect the international demand for metals to rise. At the same time, the world market for metals is becoming more and more complex, involving a great variety of players and mechanisms radically different from past decades. For instance, the concept of ‘critical metals’ (Graedel et al., 2012) has arisen. Here, two situations meet. On one hand, some consuming countries (such as France) and their manufacturing industries depend on importing a certain category of metals (antimony, rare earths, lithium, etc.) necessary for new technologies but unavailable in these countries. On the other hand, producing countries can destabilise the market thanks to their dominant position, by implementing exportation quotas for instance. Consequently, the consuming countries are at risk of shortage. To deal with these situations, the French government is suggesting the implementation of a set of prospective tools. This would allow the government to answer the following question: *given supply uncertainty, how long would a metal supply shortage last (should the case arise) in the world market and in France?* One element of this set, which we suggest here, is a prospective simulation tool based on a multi-agent system (MAS) approach. More specifically, the tool contains Agent-Based Computational Economics (ACE) models, i.e. models of artificial markets that are populated by economic interacting agents (Tsfatsion, 2006).

The goal of this paper is to report and discuss critiques by mining economists regarding an existing ACE model (see Section 2.2) that simulated the world lithium market. The motivation behind collecting these critiques is that these economists will be more willing to accept the ACE approach for the simulation of metal markets whenever the approach is appropriate. The critiques are collected by confronting the model (called ‘reference model’ in this paper) with market reality and beyond the unique case of lithium. The reference model was implemented by MAS modellers with a view to long-term development of methodologies for metal market forecasts, but mining economists need short-term operational tools and are not fully familiar with MAS. This paper does not present an alternative model (i.e. a ‘better’ tested and validated model than the reference model) stemming from these critiques, or plan to improve any agent architecture. This is a more theoretical discussion that aims: (a) to define the gaps currently existing between MAS and mining economists; (b) to indicate how the ACE model should be enhanced in the future to reduce these gaps; and (c) in parallel, to produce an improved initial metal classification that is suitable for such a modelling exercise.

Section 2 presents the state of the art for metal market modelling and includes a reminder on the reference model that we discuss throughout the paper. Section 3 presents the critiques of the model from the mining economists. Section 4 presents the responses to these critiques by the MAS modellers and suggests possible changes in the model, based on these critiques. Section 5 concludes the paper.

2 State of the art

2.1 Preamble: the general structure of metal markets

2.1.1 Classification of metals

On international markets, metals are usually divided into four categories: base metals, ferrous metals, precious metals and minor metals (Table 1).

Table 1 Metal categories and trading platforms

Category	Metals	Trading platform
Base metals	Aluminium, copper, lead, zinc, tin, nickel	London Metal Exchange (LME) and Shanghai Futures Exchange (SHFE)
Ferrous metals	Iron ore, chromium, manganese, molybdenum, niobium, vanadium	
Precious metals	Gold, silver, platinum, palladium	
Minor metals	Antimony, beryllium, bismuth, cobalt, gallium, germanium, hafnium, indium, lithium, rare earths, rhenium, selenium, tantalum, tellurium, tungsten, zirconium	FANYA Metal Exchange (at a starting stage)

London Metal Exchange (LME) and Shanghai Futures Exchange (SHFE) introduced in Table 1 are the main references for the market to obtain the global reference of prices for base, ferrous and precious metals. By contrast, for the minor metals, no complete trading platform exists for their markets. In fact, the FANYA Metal Exchange, created in China in 2011, should gradually play this role in the future, but it cannot pretend to be a centralised market place yet. In most cases, trading for this category of metals is done directly between the seller (producer) and the buyer (final industrial manufacturer), without any supervisory authority (an ‘Over the Counter’ exchange).

2.1.2 Metal markets

Metal markets should not be compared with other commodity markets. The logistics of the process of mining metallic deposits are very different from the logistics of exploiting commodities like oil and gas deposits, or of growing crops: the geological nature of metallic deposits (where one deposit can contain many metals) leads to a particular model of industrial development (the metal having higher price will be more exploited from this deposit) and, thus, specific impacts on the availability of metal-based products on international markets.¹ Generally, the following steps take place in the production process of metals: (a) *extraction*, where various metals can be obtained, some being by-products of others as a function of their prices; (b) *metallurgy treatment*, i.e. all the processes from separating the mineral of interest to obtaining a tradable chemical product (oxide, ingot, and powder); (c) *transformation* into pieces usable by the manufacturing industries; (d) *distribution* to these manufacturers; and (e) *distribution* of the final metal-containing goods (e.g. cars having batteries containing lithium, lead, etc.) to consumers.

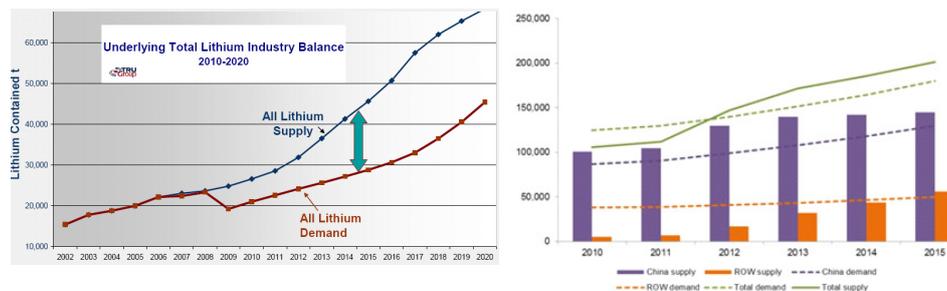
2.2 Summary on the MAS reference model

The ACE reference model (Andriamasinoro and Martel-Jantin, 2013) discussed in this paper simulated a lithium market. The product was lithium carbonate (Li_2CO_3), an

important element in the manufacture of end-use batteries. The model then excluded other products like lithium hydroxide (LiOH) or lithium chloride (LiCl).

Model design was motivated by the fact that, whereas MAS generates increasing interest in the social or economic modelling of many types of market commodities (such as agricultural commodities (Torii et al., 2006), fishing commodities (Soulié and Thébaud, 2006) or energy commodities (van Pruissen et al., 2014)), the world of geosciences has shown very little interest in MAS to model mining metal commodities. Geoscience, and especially models dealing with supply shortages, has adopted only the global scale as the level of their studies. Furthermore, to determine probable rupture periods at that level, production and consumption have been estimated in an independent manner and the results then compared arithmetically. The prospective studies are based on a simple extrapolation of current market trends. Consequently, there is no reciprocal balancing between supply and demand (absence of a systemic approach). Figure 1 illustrates this situation for lithium and rare earths, respectively.

Figure 1 Prospective evolution of the lithium market till 2020 (left) (Tru, 2011) and the rare-earth market till 2015 (right) (Roskill, 2011) (see online version for colours)



However, efforts to explore the criticality of metals should not consider only the global level, because organisational differences make a uniform analytical approach for all organisational levels (i.e. global, national and local) impractical (Graedel et al., 2012). In addition, the risks of distribution may be underappreciated when discussing resources at a pure global level (Kushnir and Sandén, 2012) because metal resources are distributed unevenly among countries. These arguments emphasise what (Labys, 2003) already concluded a decade ago regarding modelling commodity markets (including metals) and models' roles in economic development: new frontiers of research should realise that commodity market behaviour is intertwined with an international economic mechanism that includes globalisation and expanded trade as well as interactions with developed and developing macroeconomics, including related financial institutions. This new vision would allow the government of a consuming country, especially in a restriction policy context, to better evaluate the impacts of the individual behaviour and constraints from producers on supply shortage periods (if any) of this government's country.

For at least these reasons, an ACE model (the reference model in this paper summarised below) was developed. Agent-based modelling was an adequate response because it does not rule out coordination failures, instability or crisis (Lengnick, 2013), a crisis, where, in the metal market, an important supply shortage may be a future occurrence. The reference model is then, in the best of our knowledge, one of the pioneers in applying an MAS approach to supply shortage issues in metal markets.

These next subsections recall the reference model. It will, however, only present the necessary elements to understand this paper. For a more detail about the formalism of that ACE model, we refer the reader to Andriamasinoro and Martel-Jantin (2013).

2.2.1 The data source

The reference model used international trade data from GTIS (2012) as data sources. The GTIS data present flows (quantity and price) between producing countries and transit countries as well as between transit countries and consuming countries. However, only the quantity parameter had been considered by the reference model.

The prospective period of the simulation began in 2013. The historic period was between 2005 and 2012, a period when the lithium data necessary for that work were available.

2.2.2 Structure of the reference model

A country was modelled as an agent, which is either a producer, a consumer, or a transit (i.e. a country connecting producers and consumers). For various reasons (administrative, geographical, etc.), a given consumer can be supplied by the same producer via several transits.

A country may be in the following context: *Normal*, *Restriction*, *Compensation* or *Waiting*. The model also integrated agents called ambassadors which are delegate agents that handle the flow exchanged between countries (one ambassador per country peer group).

2.2.3 Behaviour of the reference model

At the beginning of the simulation, each country is in a *Normal* context. A *Normal* context is the market context of a supply without restriction. A *Restriction* context is a context where a producer country imposes a quota restriction to a consuming country.

In a *Normal* context, the interaction between a consumer cck and a producer pci via a transit tcj , at each time step of the market simulation, occurs by following the four stages below, in which the first two points concern the demand stage and the last two points concern the supply stage:

- 1 Each consumer cck having a demand $cck.sd$ asks its ambassador $A(tcj \leftrightarrow cck)$ (for each j) to calculate the quantity $d(tcj \leftarrow cck)$ to ask for from pci (for each i), the supply of which will next transit via tcj . A demand over time was calculated via two steps: (a) interpolating the time series of the GTIS data related to the demands from cck to tcj between 2005 and 2013, in order to obtain a regression line which would describe and prolong that demand evolution, and (b) removing, from the resulting interpolation, the current available stock that $A(tcj \leftrightarrow cck)$ already has.
- 2 When tcj has received the demands $d(tcj \leftarrow cck)$ (for each k) it transfers them to the ambassador $A(pci \leftrightarrow tcj)$ (for each i). The ambassador then calculates, from these demands, the part $d(pci \leftarrow tcj)$ for which pci will have to respond. This part is here calculated as being a linear regression on the GTIS data between 2005 and 2013 corresponding to $d(tcj \leftarrow cck)$ (for all k).

- 3 When the demand arrives at p_{ci} , the latter, in response, calculates the total supply $s(p_{ci} \rightarrow t_{cj})$ it will provide all consumers. In a *Normal* context supply equals demand, whereas in a *Restriction* context, p_{ci} imposes a rate restriction $p_{ci.pr}$ (with $0 \leq p_{ci.pr} \leq 1$). In any case, the supply is then sent by p_{ci} (for each i) to t_{cj} via the ambassador $A(p_{ci} \leftrightarrow t_{cj})$.
- 4 When t_{cj} has received the supplies from p_{ci} , it calculates and transfers to c_{ck} its part, via the ambassador $A(t_{cj} \leftrightarrow c_{ck})$ (for each j , the sum of which is $c_{ck}.os$). This part is calculated as being a linear regression on the GTIS data between 2005 and 2013 corresponding to $s(p_{ci} \rightarrow t_{cj})$ (for all i).

At the end of each time step, the available instantaneous stock of c_{ck} is the difference between the initial demand $c_{ck}.od$ and the final supply $c_{ck}.os$.

A *Compensation* context is a context where a producer country attempts to partly make up the lack resulting from that restriction by another country. In a *Compensation* context, a consuming country receiving a restriction from p_{ci} (let $i=r$) changes its context from *Normal* to *Compensation* and asks all p_{ci} ($i \neq r$) to make up the lacking stock. Each p_{ci} that receives the message and accepts to make up either immediately switches its context from *Normal* to *Compensation* or waits for a delay. In the latter case, it first switches its context from *Normal* to *Waiting* before switching from *Waiting* to *Compensation*, once this delay expires. This delay may be necessary for diverse reasons specific to p_{ci} : inability to immediately respond, speculation, etc.

2.2.4 Simulation of the reference model and results

The selected producing countries (p_{ci}) were Chile (cl), China (cn) and the USA (us). The model also added a (*virtual*) country called the rest of the world (rw). The selected consuming countries (c_{ck}) were France (fr), the subject of that study and, again, the rest of the world (rw). Finally, the transit countries (t_{cj}) are Belgium (be), Germany (de), the UK (uk), Italy (it) and the Netherlands (nl). The model also added, again, the rest of the world (rw). All the ambassadors were next naturally created to connect all these countries (rw included). To comply with the available data in GTIS, the simulation time step is three months. We note, for example, quarter two of year 2019 as 2/2019.

The pattern of the proposed (and currently fictitious) prospective scenario was the following: one assumes that as of 2014, Chile restricts its supply rate by $cl.ps$ points. Following this situation, China accepts assuring compensation at a rate of $cn.pp$ points, and does so immediately. The USA also accepts, with a rate of $us.pp$ points, but only as of 2016. The purpose of the simulation then consisted in varying the values of these rates to find the shortage end date in France and in the rest of the world.

Table 2 shows in detail the list of different scenario instances proposed in this paper. An instance is made of the scenario identifier (written in brackets), the value of the restriction from Chile and the value of compensation, respectively, from China and the USA. The value chosen in Table 2 also allows a policy-maker to analyse the sensitivity of the lithium market after a variation in important indicators (e.g. here, the diverse rates).

The left of Figure 2 next shows the shortage end dates obtained for the rest of the world in all scenarios. In this figure, the value of 13,000 (in t /quarter), in absolute values, approximately represents the average demand of lithium of rw (according to GTIS).

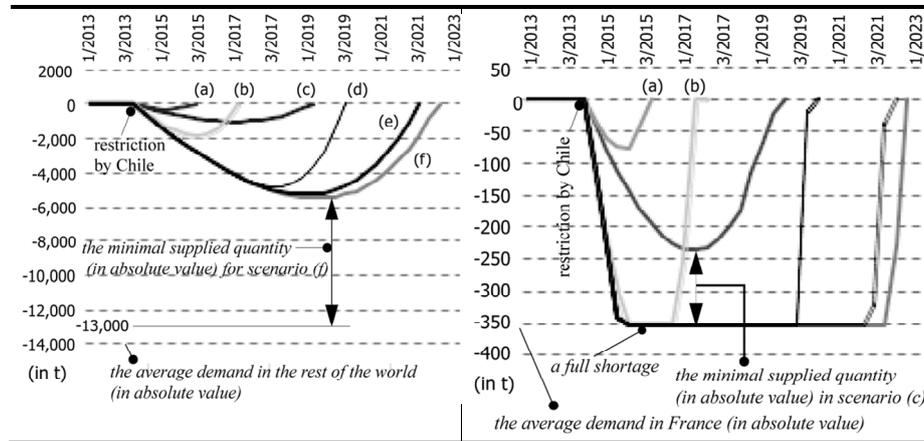
It means for example that in scenario (f), at the peak time of a supply shortage period, there is still a minimal value of around (13,000–5800) *t*/quarter of lithium (more than 50%) which is supplied to this consumer.

Table 2 Of all the scenarios, an instance being composed of a restriction from Chile (cl) followed by a compensation from China (cn) and the USA (us)

<i>id</i>	<i>-cl.ps</i>	<i>+cn.pp</i>	<i>+us.pp</i>
(a)	-0.15	+0.3	+0
(b)	-0.4	+0.3	+0
(c)	-0.15	+0.1	+0
(d)	-0.4	+0.1	+0.5
(e)	-0.4	+0.1	+0.1
(f)	-0.1	+0.1	+0

The right of Figure 2 is the ‘France equivalent’ of the left side, with an average demand of around 350 *t*/quarter (according to GTIS). In this figure, France reaches a full shortage in all the scenarios where the Chile restriction is high (-0.4), i.e. (b), (d), (e), and (f) and with different durations. The reason of this full shortage is that the linear regressions made on the GTIS data result to a behavior where the model first handles the rest of the world (rw). When the stock is close to 0 again for rw, then France is automatically considered.

Figure 2 Prospective evolution of the lithium stock in the rest of the world (left) and in France (right), for all scenarios



2.2.5 Summary of the MAS reference model

The MAS reference model is a purely bottom-up model, i.e. it does not have any central mechanism to drive the interactions between producers and consumers. Furthermore, the maximum value of (year) 2023 mentioned in Figure 2 is not a time limit imposed by the model user, but an emergent result obtained during the simulation: it was observed that none of the periods of shortage exceeded this year. However, the model was designed not

as a substitution for classical statistical or mathematical approaches but rather as a complement (coupling) to them. Statistical approaches have been integrated to describe not a global phenomenon, but the behaviour of certain agents to which the approach is suitable. It particularly concerns the ambassadors. The linear regression tests were used with this objective. In the resulting system, certain agents behave in a linear manner (ambassadors and transit countries), while others (producing and consuming countries) adopt more complex and more discrete behaviours, which depend on their context.

3 Critiques of the MAS model from mining economists

Relying on macroeconomic and microeconomic reasoning and arguments, mining economists highlight various limits of the reference model when it has been confronted to ‘real world’ situations. The corresponding critiques are categorised into four aspects: the data source, the structure, the behaviour, and the simulation. They are detailed below and are followed by conclusions and indicators to improve the model performance. MAS responses to these critiques will next be provided in Section 4.

3.1 Regarding the data source

The data source GTIS (which originates from customs data) only contains flows between countries. It does not consider internal country consumption and production. In addition, there is a non-traceability issue. It means that if GTIS and more generally any customs data source like EUROSTAT or USGS – the United States Geological Survey – are (relatively) accurate concerning the quantities of primary products exchanged between countries, they do not trace the quantities of exchanged metals when they are already included in end-use products (e.g. quantities of lithium in traded cars). Non-traceability issues also means that, for some metals (e.g. rare earths), there is a multiplicity of codes corresponding to different products containing the metal in its different forms. Table 3 gives an example of the issue in the data source (EUROSTAT, 2014) for rare earths. In this table, there are similarities between the products having different codes, making traceability difficult.

Table 3 HS codes for raw rare-earth product imports and exports (EUROSTAT, 2014)

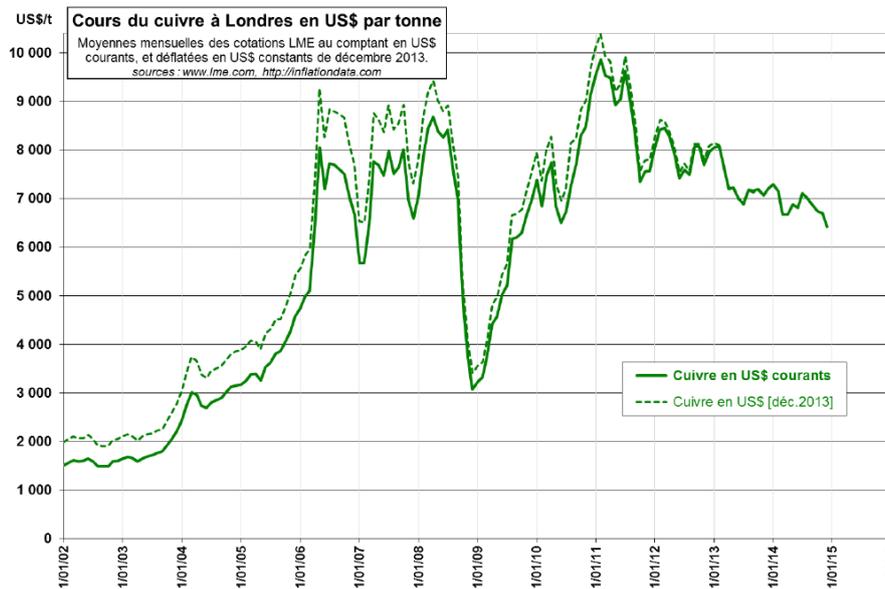
<i>HS code</i>	<i>Description in EUROSTAT</i>
28053010	Intermixtures or interalloys of rare-earth metals, scandium and yttrium
28053090	Rare-earth metals, scandium and yttrium (excl. intermixtures of interalloys)
28461000	Cerium compounds
28469000	Compounds, inorganic or organic, of rare-earth metals, of yttrium or of scandium or of mixtures of these metals (excl. cerium)

3.2 Regarding the simulation

The time step chosen by the reference model is three months and the main agents are only countries. As the prospective exercise is on a long term ($\approx 10\text{--}15$ years – cf. Figure 2), these choices seem to be correct.

However, it should be kept in mind that when the prospective exercise is on short ($\approx 2-5$ years) to medium terms ($\approx 5-10$ years), these choices (three-month time step, only country agents, etc.) are questionable. Indeed, at those scales, major industrial companies also have roles, particularly via the influences of their quarterly to bi-annual published results on daily and monthly evolutions in prices and exchanges. The example of the copper prices presented in Figure 3 indicates that their cycles are becoming tighter and tighter, requiring the simulation time step to be reduced accordingly. As metal market prospective studies may also cover short- and medium-term scales, this aspect should be considered in future work when appropriate.

Figure 3 Variation of the copper price between 2002 and 2015 (BRGM, 2015) (see online version for colours)



3.3 Regarding the structural aspects

The agents' structures lack properties which could influence greatly the outcomes. Indeed, the reasoning and equations only take quantities of 'lithium carbonate' as the input variable, while many other factors would need to be taken into account:

- In the 'ambassadors': price, geopolitical relations between countries, etc.
- In the '(producer) countries': costs of extraction and transformation (economic viability of the project), costs of transportation, etc.
- In the '(consumer) countries': internal demands, evolution of technologies, etc.

It is also noted that the model does not contain the secondary circuit at all that would allow evaluation of the quantities of metals that can be obtained by recycling end-use products.

3.4 *Regarding the behavioural aspects*

3.4.1 *On the demand side*

The forecasting technique adopted by the demand model is based on extrapolation of historical data, resulting in the linear trends presented in Figure 2. Effectively, such an extrapolation technique was frequently used by the literature to analyse long-term metal market forecasts. We can cite for instance Roberts (2009) who analysed the prices of 14 metals from January 1947 through December 2007 and Shafiee and Topal (2010) who analysed the prices of gold from January 1968 to December 2008.

Again, in conformity with comments regarding simulation time step (cf. Section 3.2), extrapolation may no longer be accurate to analyse medium-term trends of commodity prices and stocks. Indeed, there has been an important change in market fundamentals over at least the last two decades. Finance mechanisms have progressively been applied to commodity markets and have taken on non-negligible importance in their evolutions, introducing new key players such as banks and investment funds. In short, first-order fundamentals (meaning global supply and demand, exchange rates, etc.) have become insufficient to represent the market structures and dynamics. There are now a number of second- or third-order parameters to take into account (speculative buyer behaviour, shadow banking, resource nationalism, etc.). In addition, demand trends are becoming harder to forecast by relying on past data because, for most minor metals, they depend on the expansion of new promising technologies where they find their end-use. All these situations also apply for short-term forecasting, where non-linearity of economic data has already been admitted for decades (Agnon et al., 1999).

3.4.2 *On the supply side*

On supply side, the reference model put the strong hypothesis that when demand increases, producers can always increase their production capacity to respond accordingly. Unfortunately, the mining industry does not always allow such a mechanism. One of the best examples is rare earths: when China diminished its export by 40% in 2010, none of other producers could effectively compensate such a shortage even though other resources had been identified. The reason is that the industrial treatment facilities were not operational at that time. Currently, there are (non-exhaustive) factors that do not allow the above hypothesis to be realistic: availability of the resources, prices, political factors and internal demand of producing countries, which we explain below.

Availability of the resources: the strong hypothesis above primarily implies that the resource of compensating producers can compete in quality and price with the restricting producer's resources. This parameter is far from obvious and raises the question: if other producers were able to supply more lithium before, why did not they do so? Most of the time, technical constraints explain this. These remain high barriers to alternative producers, who cannot modify their production instantaneously.

Prices: if the reaction of Chile restricting its lithium exportations could be a brutal evolution of lithium market prices, then other producers would also be affected by such a change and could also react by reducing their production voluntarily, awaiting better prices. Indeed, extraction cost is one of the main parameters in determining the rate of production of a mine so that only high enough metal prices can be a credible incentive to increase production (and only if technically feasible).

Political factors: related to the previous argument, price distortion raises the question of the possibility of ‘organised’ market failures, such as monopolistic or oligopolistic situations, arrangements between producing countries, and free-rider issues. In such cases, price distortion could be advantageous for some producers and they would not take any measure to resolve the shortage issue quickly, similar to what OPEC members have done in oil price crises, for instance. The reference model tried to take this aspect into account by introducing a *Waiting* step, allowing for a differed response from some countries, but the determinant of the corresponding variable is currently exogenous and set arbitrarily. Finding the determinants of this variable would be interesting.

Internal demand of producing countries: as producing countries usually import part of their supply from restricting producers (e.g. a large part of China and the USA’s lithium also comes from Chile), those countries would also be affected in case of a uniform restriction (i.e. a restriction applied to all connected countries). Their eventual extra-production would then be used first for internal needs, rather than for international markets. Besides, since the chosen customs data (GTIS) do not take into account internal consumption (cf. Section 3.1), the supply value is not accurate.

3.5 Conclusions from the economists

MAS seems to be a promising approach to analyse metal markets. However, according to the mining economists, it is far from convincing for operational use. The reference multi-agent model described in this paper still needs a lot of refining to be able to describe market situations that are close to reality. In particular, the following questions are posed:

- How can the MAS approach reproduce high non-linear variations of metal market supply, demand and prices for the short or medium term, in an endogenous way?
- How can MAS integrate the complex characteristics of some metal markets (e.g. those involved in the exploitation of the 17 groups of rare earths)?
- For which spatial and temporal scales is MAS modelling more appropriate? Can the approach handle multi-scale situations?

Nonetheless, through this work mining economists have provided a first category of metals that are more suitable for MAS modelling: base metals (copper, aluminium, iron, nickel, etc.), which are less critical than minor metals (antimony, indium, lithium, rare earths, etc.) (cf. Table 1 for these categories). The main reason for concluding this is data availability. In fact, in the metal market field, there is an inverse relation between data availability and its criticality. This is due at least to the following reasons: (a) the quantity of metals produced (a few or hundreds of tons for minor metals compared to millions or billions of tons for base metals), while some data sources ignore quantity below a threshold, (b) the way metals are traded as explained in Section 2.1.1; and (c) the speculation around their transformation into high value-added products.

Regarding the non-traceability issue outlined in Section 3.1, to temporarily bypass this issue, the economists suggest that future ACE models should limit the number of end-uses they manage while diversifying and cross-validating different sources of data (GTIS, EUROSTAT, USGS, Study Groups and Producer Associations, etc.). Limiting means avoiding (at least for the moment) simulating a primary product intended for too many industry end-uses. This was what has been done in the reference model with lithium carbonate (mostly used for lithium-ion batteries) but the reasoning is valid for

any metals. Obviously, this will not solve the non-traceability issue itself. This issue could be progressively resolved only if manufacturing producers would communicate more about the quantities of metals contained in their products. Meanwhile, this temporary solution will allow the progress in evaluating the MAS approach.

3.6 Economists' suggestions for future work

One suggestion from the economists to progress in evaluating the approach and the downstream modelling exercise is demonstrating MAS capacity via a showing-by-doing approach (Hamill, 2010). This would implement an ACE model which can reproduce the price behaviour of some metals during a period containing the last crisis. The crisis scenario would be the following:

- an expected increase in demand of technologies which are dependent on a specific minor metal (cell phones with tantalum, new technologies with rare earths, etc.);
- 'consumerist euphoria' and a speculative bubble by the producers;
- industrials and financial players building strategic stockpiles, reducing the available raw materials and leading to crazy price increases; and
- a sudden decrease in demand and consequently price.

Another suggestion for future models is to consider integrating other flow modelling techniques, including the Modelling Flow Analysis (MFA) approach. This technique would be applied to analyse, for a given time/metal, how the input (instock, importation, production, etc.) evolves to output (consumption, outstock, exportation, etc.) for each country. This is important because in the current reference model, the flows circulating inside a country have been modelled in a 'simple' way: for example we cannot see: (a) for a producer like the USA, its importation, (b) for a consumer like France, its exportation, and (c) for transit like Belgium, a more precise analysis on which imported quantities are kept inside the country and which are exported to the final destination. MFA may be an interesting complementary approach to identify such lacks.

4 Discussion

This section summarises how the MAS modellers respond to the economic critiques from Section 3, with a view to taking them into consideration appropriately in future modelling work.

4.1 Justification for using the MAS approach

Before answering the critiques, it is worth recapping the interest of MAS especially for policy-makers.

In fact, the debate on the methodological foundations of macroeconomic theory has gained new momentum during the recent worldwide economic crisis (Lengnick, 2013), a crisis where, in the metal market, an important supply shortage may be a future occurrence. Jean-Claude Trichet, the former President of the European Central Bank, states the following (Trichet, 2010): '*... As a policy-maker during the crisis, I found the*

available models of limited help (...) in the face of the crisis, we felt abandoned by conventional tools (...). We need to deal better with heterogeneity across agents and the interaction among those heterogeneous agents (...) Such approaches are worthy of our attention ...'. That is why practitioners, governments and central banks are today very conscious that their understanding of the economic mechanisms has to be improved so that the linkages between various countries' (agents') systems at the international level can be demonstrated more explicitly, linkages which affect aggregate behaviour (Kirman, 2011).

This necessity for scale change also applies to the particular case of metal supply shortage risk according to most of the studies measuring metal criticality gathered by Speirs et al. (2013). In fact, those studies, although carried out at only aggregate level, are interesting for policy-makers because: (a) they are currently used operationally as a decision-aid model by industrialists, the European Union (EU), etc., and (b) they contain rich criticality determinants like geopolitical factors (governance, transparency, etc.), geological factors (substance availability, etc.), environmental factors, and economic factors (supply concentration, etc.). However, one limit of these studies is that they tried to assign a unique aggregated criticality score. Criticality differs from one country to another (depending for example on the geological reserves of the respective countries). The above authors then suggest future studies that would make the interaction between variables resulting in this unique score more explicit. Again, MAS is a solution. The idea is to design a 'country version' of these indicators inside an ACE model (cf. Section 4.3 for a first indicator).

In sum, we have here a research aspect (MAS) and an operational aspect (critical metals indicators at an aggregate level) that are currently attracting the attention of policy-makers for analysing metal criticality, especially as both aspects can be (theoretically at this stage) coupled inside one model.

4.2 *Regarding the comments from the economists*

Regarding simulation aspects (Section 3.2), comments related to the scale and complexity clearly demonstrate a lack of communication between the MAS field and the mining field concerning the foundation of MAS and its potential. MAS can simulate complex systems (Wooldridge, 2009) and can handle multiple time scales such as (if we take examples of ACE models) a day scale (Vriend, 2006), a month scale (Lengnick, 2013), a quarter scale (the reference model in this work), a year scale (Cheng et al., 2009), etc. MAS can also handle multiple space scales (if we look at the above work again): firm, household/country/world and can consider 'financial agents' like banks (Tsfatsion, 2006).

Regarding behavioural aspects, the strong hypothesis (i.e. assuming that compensations of Chile's restriction by China and the USA are always possible) noticed by the economists can be explained as follows: the current ACE work is one of pioneers in the mining field and is also a part of a methodological development in metal market forecasts. So (conceptually) assuming that when producer countries restrict, other countries compensate to maintain a market equilibrium is common sense. This could not simply be verified in the reference model because this model has missing parameters (cf. Section 3.2) and the corresponding missing behaviours. That said these comments to avoid a strong hypothesis must be obviously integrated in future simulations to make the model realistic and usable at an operational level.

Regarding structural aspects and the missing (economic, geopolitical and environmental) parameters in the reference model, there are no particular comments from the MAS modellers given that they are also aware of these lacks. Geopolitical variables will be integrated into our future work by relying on work concerning metal criticalities as outlined in Section 4.1. In fact, that work not only suggested what geopolitical variables to add to countries (e.g. governance indicators) but also indicated the corresponding data sources (World Bank, Transparency International, International Monetary Fund, etc.).

Regarding data issues and particularly the non-traceability issue, the MAS field cannot solve this alone. At this time MAS will follow the recommendations from the economists (cf. Section 3.5): simulating one specific product intended to one specific industry end-use while diversifying and cross-validating different data sources (GTIS, OECD, EUROSTAT, USGS, etc.).

Regarding the economists' expectation of introducing MFA, the comments clearly highlight the wish to reinforce the coupling of classical and MAS approaches in the modelling of metal markets instead of sticking to a solely MAS approach. This means MAS should be considered as a complementary approach rather than a substitute for the classical approach. The reference model had already started to consider this idea (i.e. coupling MAS and statistical approaches – cf. Section 2.2.5). But for future model developments, it could be further enhanced by henceforth methodologically extending the coupling to the other approaches. Concretely, these approaches are: (a) material flow analysis, (b) work on metal criticalities mentioned above (which integrate geopolitical variables), (c) spatialisation processes via geological maps and country maps (which consider geological variables and transport distances respectively), and (d) metal Life-Cycle Analysis (LCA). Metal LCA (Nuss and Eckelman, 2014) will be introduced in future ACE work to evaluate the environmental impact of metal exploitation as recommended by the EU (2011) but, in this case, inside an MAS simulation. This coupling to LCA can be carried out by considering environmental properties (energy end-use, global warming potential, human health implications and ecosystem damage) in agents' properties and how they are manipulated in agents' behaviours (mining, transport, transformation, recycling, etc.).

Throughout these actions, the MAS modellers are aware that it is incumbent on MAS simulation, for better acceptance of its usefulness, to justify its added value in enriching existing methodologies regarding metal market analysis, not the opposite.

4.3 How to create the showing-by-doing demonstration

This section explains how the MAS modellers plan to actualise the showing-by-doing demonstration requested by the mining economists, i.e. reproducing some metal price behaviour covering periods of the last crisis (cf. Section 3.6).

4.3.1 The metal

Simulating rare-earth markets and its 17 groups of elements, as expressed by the mining economists in Section 3.5, is too premature at this stage although more interesting (because critical) and conceptually possible via MAS approach. The chosen metal for that demonstration will be copper. Since this is a medium-term simulation, the exercise

will be carried out at a month-time step (not the quarter-time step adopted by the reference model) and with the idea of reproducing high price variations (cf. Figure 3) and demand in an endogenous way.

Copper is chosen for the following reasons and more:

- Copper's economic data (price, quantity) are more available than data on lithium or rare earths, not only for import–export flow but also for production and consumption inside a country (see Section 3.5 for the explanation). This is true not only for all primary or secondary (recycling) circuits of this metal (via GTIS, EUROSTAT, IMF, etc.) but also for environmental evaluation (the eco-invent database).
- Copper end-use is, at more than 50% of market share, intended for the construction and automotive sectors where data are more available than for some other metal end-uses. For a modelling exercise, these data (sharing more than 50% of end-use market) are not negligible so they diminish the effect of the non-traceability issue.
- We could refer to recent studies on the criticality of copper (i.e. including geopolitical aspects) (Nassar et al., 2011).

4.3.2 Baseline of the future ACE model

Regarding the future copper ACE model, the following baseline indicators are suggested.

The design of links between producers and consumers would be modelled by direct sequences of ask-bid processes between producers and consumers according to their local knowledge of the market. The future work would then keep the fully bottom-up approach adopted by the reference model (cf. Section 2.2.5) while avoiding the extrapolation process limiting that model as argued in Section 3.4.1. The future work would also rely on the work like Cheng et al. (2009). That is interesting because: (a) it considers additional market agents (hedgers, traders, etc.), (b) during an ongoing simulation, it considers different market external events that drive complicated price movement with only simple agent strategies, and (c) it has been applied to the simulation of world crude oil price evolution, theoretically facilitating its transposition to our copper trading market. Figure 4 shows an example of the efficiency of such a model, in particular the ability of one agent trader to progressively comply with the trend indicated by real-world market price.

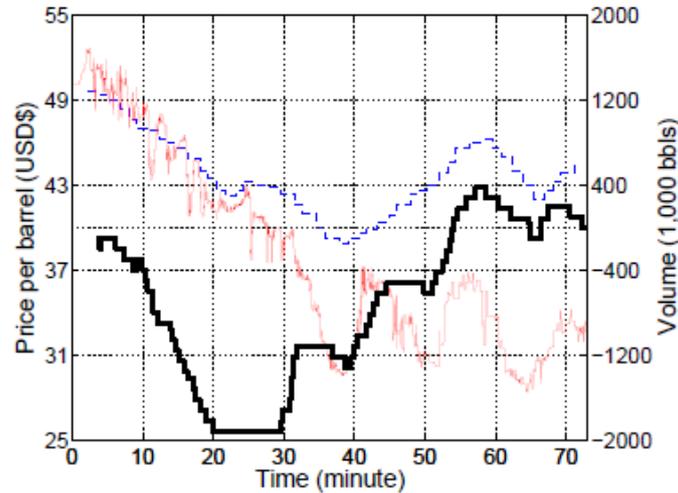
Regarding the evaluation of the demand in that future work (mostly in the construction and automotive sectors, as mentioned previously), it would rely on the ACE work like Lengnick (2013). That work is a fully bottom-up market model that computed agents' demands according the household needs (i.e. a variable from which construction and automotive needs could also be computed).

4.4 Regarding the future of MAS acceptance

It seems to be clear that MAS is a promising tool for prospective simulation of metal markets, among other reasons, because it would be of interest for a policy-maker (Section 4.1) in market analysis after the recent economic crisis. MAS is also open enough to be theoretically coupled with more classical existing approaches (Section 4.2). However, while the intention behind these MAS responses is to conform as close as

possible to mining economists' suggestion, success will be defined by the economists accepting MAS and is far from obvious for at least two reasons: data obstacles and paradigm obstacles.

Figure 4 Example of a trader agent behaviour (Cheng et al., 2009) (see online version for colours)



Note: Thick line is trader's position balance; thin line is real market price; and dotted line is estimated market price dynamics.

4.4.1 A data obstacle

As demonstrated in the entire paper, the data available in metal markets are not 'ready' yet for MAS simulation. One reason is because the industrial metals market at an international scale has never considered the necessity of constructing and organising data for a simulation purpose. In addition, at more detailed levels, data are confidential to varying degrees, published according to criteria variable from one country to another (the metal, the producing company, the country, etc.). Consequently, although rare earths would be the next metal whose market is interesting to simulate for the showing-by-doing MAS demonstration suggested by the economists (i.e. the capability for simulating the last crisis), copper was finally chosen not because it is the most critical metal but because its market has one of the best quantities of available data. It is hoped that once a future copper model is implemented and validated, the resulting work would incite the mining field to progressive collection and validation of raw material data at the international level for a simulation purpose. The medium-term idea is to concretely succeed in creating a cyclic process between (a) increased successful transpositions of the reference model, (b) better organisation and reliability of data, (c) better acceptance of the underlying method, and (d) progression in the demand of MAS approach for studies from different entities (consultants, scientists, etc.) at an operational level. Such a cyclic process already exists and is recognised at an operational level but only for a global level, not at an international level.

4.4.2 A paradigm obstacle

Even though it is assumed the showing-by-doing test expected by economists would produce interesting results, we detected many sources of reluctance in using the approach. First, we recognise that from the economist's viewpoint, agent-based modelling has an obvious drawback: it makes it impossible to think in aggregate terms. Multi-agent modelling also has a destructive consequence: the dimension of the model explodes (Assenza and Delli Gatti, 2013). Second, an MAS is composed of autonomous agents and emergent phenomena while mining economists would like to 'keep control' of their analysis, i.e. not letting computers reason in lieu of them. Third, how long it will take to design one application scenario is not clear and, during a simulation, the time each agent will take (in real time) to behave is not clear either. There is an uncertainty on how many times, at the most, such potential users should wait before obtaining one scenario result (at a scale of a minute? a week?). All of these sources of reluctance are unlikely to disappear in the short term but we should at least constantly highlight them in future MAS research papers concerning progress towards better acceptance of the MAS method in the metals field.

5 Conclusions

In coming years, mining economists expect the international demand for metals to rise. Market distortions are likely to appear because producing countries controlling the resources can implement exportation quotas for certain categories of metals, for political or environmental reasons. Consequently, consuming countries like France are facing increasing risks of shortages for some metals. In response to that, the French government suggests the implementation of a set of prospective tools which is a prospective simulation tool based on an MAS approach. The goal of this paper was to report and discuss critiques carried out by the economists regarding the value and ability of an MAS to simulate critical metal markets whenever the approach is appropriate. The critiques were collected by comparing an existing ACE model of the lithium market to market reality and by generalising the discussions to other metals. The motivation is: (a) to define the gaps currently existing between MAS and mining economists; (b) to provide indicators on how the ACE model should be enhanced in the future to reduce these gaps; and (c) in parallel, to produce an improved initial metal classification that is suitable for such a modelling exercise. We can summarise the results as follows.

First, finance mechanisms have progressively taken on non-negligible importance in the evolution of macroeconomics (and even more so metal markets, a field of macroeconomics), introducing new key players such as banks and investment funds. Practitioners, governments and central banks are today very conscious that knowledge of the economic mechanisms has to be improved so that the network structure of the financial industry can be more explicitly demonstrated at an international level, a structure which next has an important impact on aggregate behaviour. Consequently, unlike what is proposed by the reference model, prospective modelling of metal market demand by only extrapolating its historical data will be less and less appropriate. Trends

are becoming harder to forecast by relying on past data because, for most of the minor metals, they depend on the expansion of new promising technologies in which they are used, which could eventually be replaced by even newer technologies in a decade-long period. In sum, demand and price variation will be more and more non-linear and the prospective modelling technique should be improved to better identify the determinants of that evolution.

Second, an MAS approach and more specifically, for this work, ACE models, are conceptually recognised as appropriate for simulating the complex metal market as described above. The recognition comes not only from scientists but also from policy-makers, especially after the recent economic crisis. Nonetheless, we also recognise that there is a lack of communication to mining economists regarding the MAS foundation and potential for simulating such a market. Thus, for progress towards a better acceptance of MAS by the economists:

- Mining economists expect demonstration by a showing-by-doing approach, in particular an ACE model which would be capable of reproducing high price and demand variation of for a metal during a period including the recent crisis in an endogenous way. Copper will be chosen for that demonstration.
- Classical modelling approaches should be more and more highlighted in the model as far as appropriate, instead of a solely MAS structure.

Third, available data in metal markets are not 'ready' yet for MAS simulation. Consequently, although rare earths would be the next metal whose market was interesting to simulate, copper has been chosen not because it is the most critical metal but because its market has one of the best quantities of available data. More generally, this work has allowed mining economists to provide a first category of metals that is more suitable for an MAS modelling: base metals (copper, aluminium, iron, nickel, etc.) rather than minor metals (antimony, indium, lithium, rare earths, etc.). It is hoped that once a future copper model is implemented and validated, the resulting work would incite the mining field to progressively collect and validate more critical metal data at the international level for a simulation purpose.

Finally, we recognise that even though it is assumed that the showing-by-doing test expected by mining economists would produce interesting results, they will still be reluctant to adopt the MAS approach as a tool at the operational level, at least in the short term, among other reasons because (a) they are used to keeping control of their analysis, while MAS provides autonomous agents and emergent mechanisms, and (b) MAS currently contains a level of complexity that is not still suitable for them in terms of model and simulation designs. These sources of reluctance will not immediately disappear but we should constantly highlight them in future MAS research papers to aid progress towards better acceptance of the MAS method in any application.

In terms of perspectives for the present work, the next step is to achieve the showing-by-doing demonstration. We plan to base that work on ACE models already existing in the literature (Cheng et al., 2009; Lengnick, 2013).

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Note

- 1 Such heterogeneity exists less in other commodities