GLOBALISATION OF CORPORATE INVENTION

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Outline

- Introduction
- Conceptual framework
- Data and Methods
- First results and preliminary conclusions
- Current work and further research

Introduction 1/2

- This paper presents the conceptual and methodological issues of using patents to investigate the dynamics of corporate invention.
- We introduce the Corporate Invention Board (CIB) which complements the “Industrial R&D Investment Scoreboard” to analyse the inventive performance of companies.
- Through priority patents’ statistics, CIB focuses on the outputs of R&D investments combining information extracted from the “Patstat” patent database and from the “Orbis” financial database. Thus, CIB provides information on technologies and on localisation of investments and inventions.

Introduction 2/2

- Innovation is increasingly recognised as a driver of productivity and economic growth, as well as a vital resource in addressing societal challenges.
- The globalisation of innovation raises crucial scientific, management and policy issues.
- We currently have only some approximate and contrasting views about the patterns of globalisation of corporate invention that emerged in recent years.
- International patterns of industrial R&D investments still remain largely a statistical “blind spot”.
- While it is clear that globalisation is an important phenomenon, it does not represent a uniform development.

Conceptual Framework 1/2

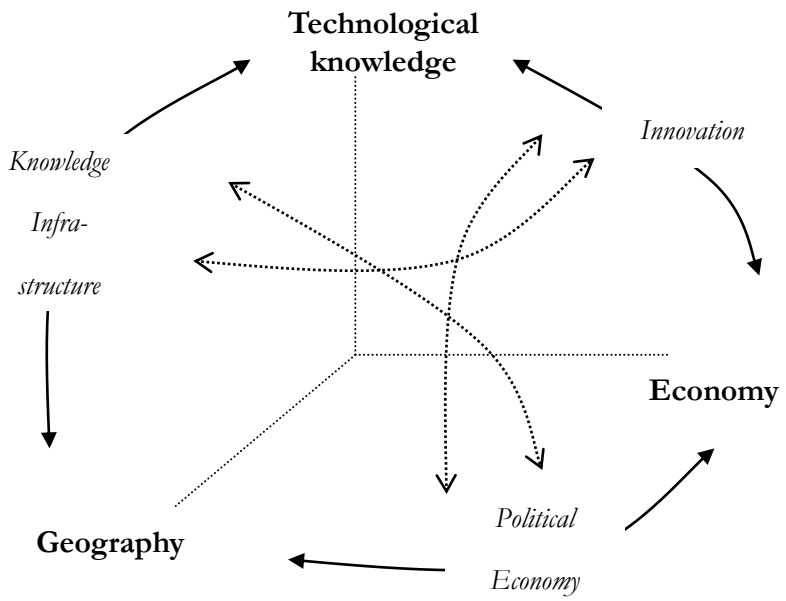
- First, existing studies in economic geography show that countries and regions tend to expand into activities that are closely related to their existing activities

- Second, innovation literature shows that multinational groups operate on the basis of evolving routines that are different among sectors.

- Third, formal evolutionary models have shown that technology evolves. Existing technologies provide building blocks for further technological development.

Conceptual Framework 2/2

- Interactions between i) capabilities at geographical locations, ii) evolving technologies and iii) the routines of groups are multidirectional and involve positive and negative feedback loops.
- In other words, geography, economy and technology interact and shape each other in a process of co-evolution.



Data and Methods 1/4

- The CIB complements the “Industrial R&D Investment Scoreboard 2008” that analyses the performances of the 2000 industrial companies (1000 based within the European Union, 1000 outside) with the highest annual R&D investments.
- Through patents’ statistics, we focus on the outputs of these R&D investments providing information on technologies and on geographical location of these investments.
- CIB analyses a very significant share of private R&D investments: the industrial corporations studied in the project account for 80% of world total private R&D.

Data and Methods 2/4

- 433 Indian and Chinese companies have been added, based on R&D investments between 1999 and 2009 as identified from the Compustat database.
- We checked as well the main assignees of patents identified in the management reports of the Worldwide Industrial Property Organization (WIPO), the European Patent Office (EPO), and the United States Patents and Trademark Office (USPTO).

Data and Methods 3/4

- The propensity to patent in a foreign country varies from nation to nation depending on a variety of factors
- In order to have a patent-based indicator adequate for international comparison, we consider only priority patents registered by more than one country; a category we label “transnational priority patents”.
- Transnational priority correct national specificities that affect most the quantitative characterization of inventive activities.

Data and Methods

- The CIB analyses five attributes of the patent documents that provide information on the geography, economic sector and technology of corporate invention.

1. patent’s assignee’s name, which links an invention to the industrial group it belongs to.
2. the nationality of the global ultimate owner of the invention (the corporation’s home country, i.e a 200 classes break down
3. the sectoral affiliation of this corporation (pharmaceuticals, chemical… i.e. a 40 classes break down).
4. the private address of the inventor, characterising the place of invention
5. the technological areas which are established by using in the WIPO’s international patent classification

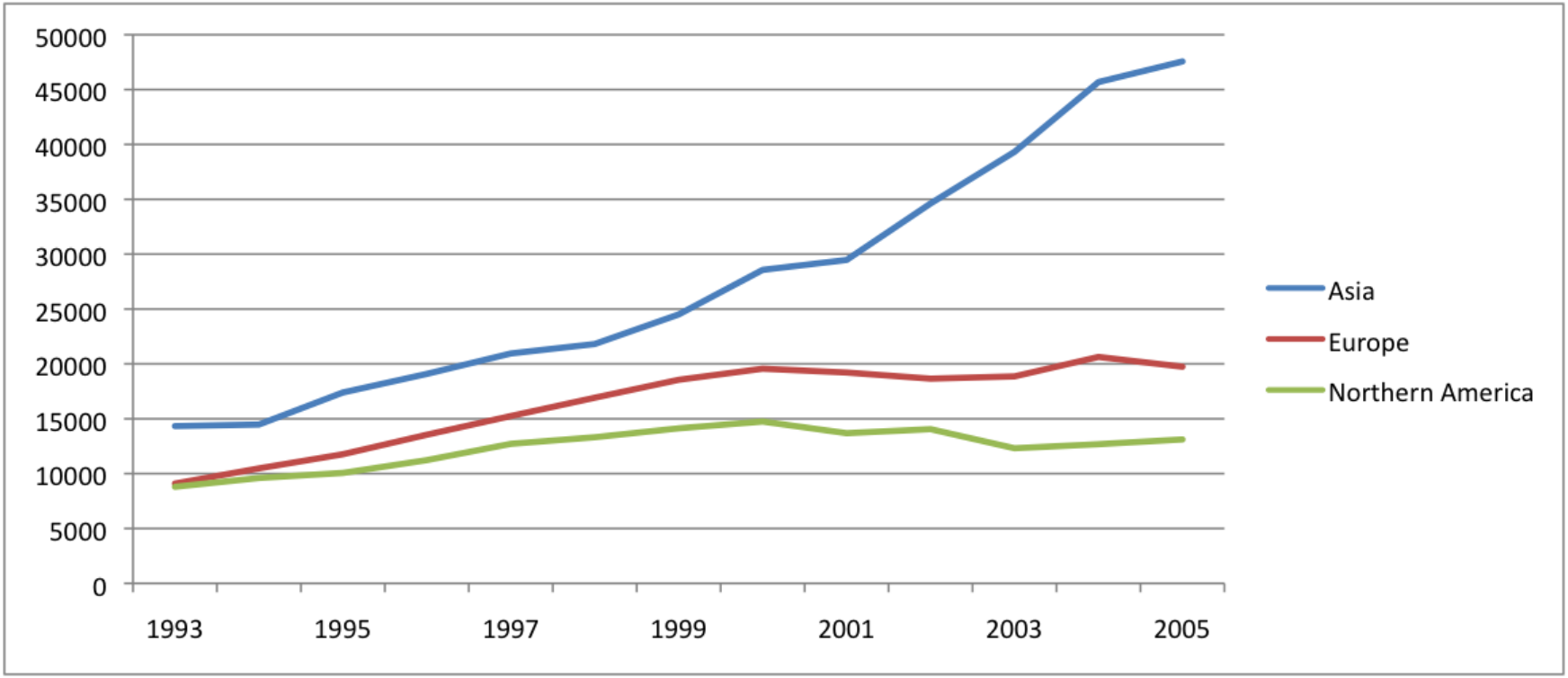
Dedicated website: **www.CorporateInventionBoard.eu**

Results

CIB portfolios : priority patents			CIB portfolios : transnational priority patents		
HQ located in	**count**	**World share**	**HQ located in**	**count**	**World share**
JP	3 928 896	69,32%	JP	384195	37,66%
US	629 603	11,10%	US	226068	22,16%
KR	388 013	6,84%	DE	141115	13,83%
DE	264 161	4,66%	KR	63446	6,22%
FR	90 901	1,60%	FR	52444	5,14%
GB	59 131	1,04%	GB	26499	2,59%
TW	56 613	0,99%	NL	22203	2,17%
CN	47 186	0,83%	CH	18178	1,78%
CH	37 710	0,66%	SE	18015	1,76%
NL	34 858	0,61%	FI	14976	1,46%
Total world	5 667 253	100%	Total world	1 019 989	100%

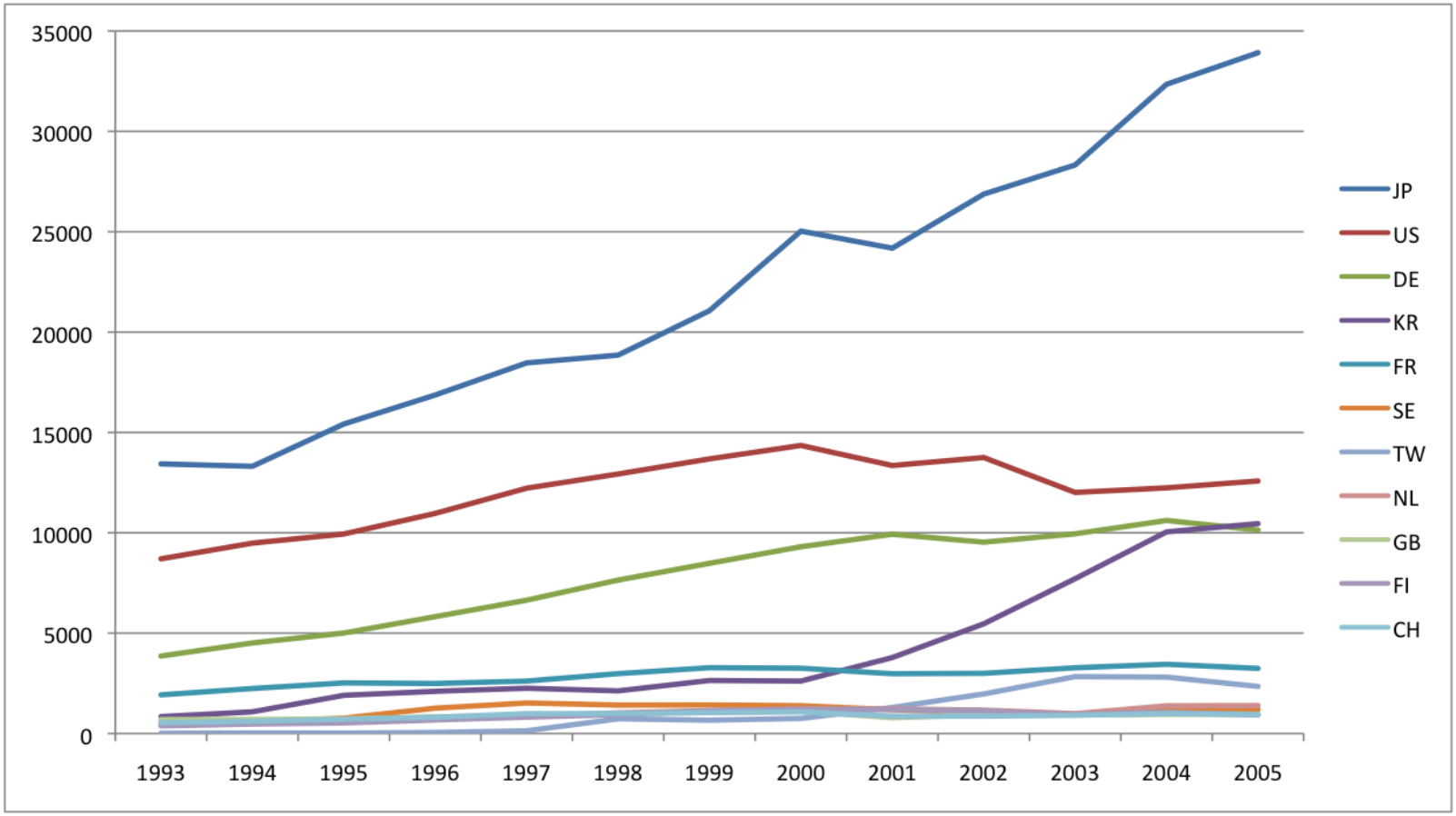
Results

Transnational priority patents according to GUO continent

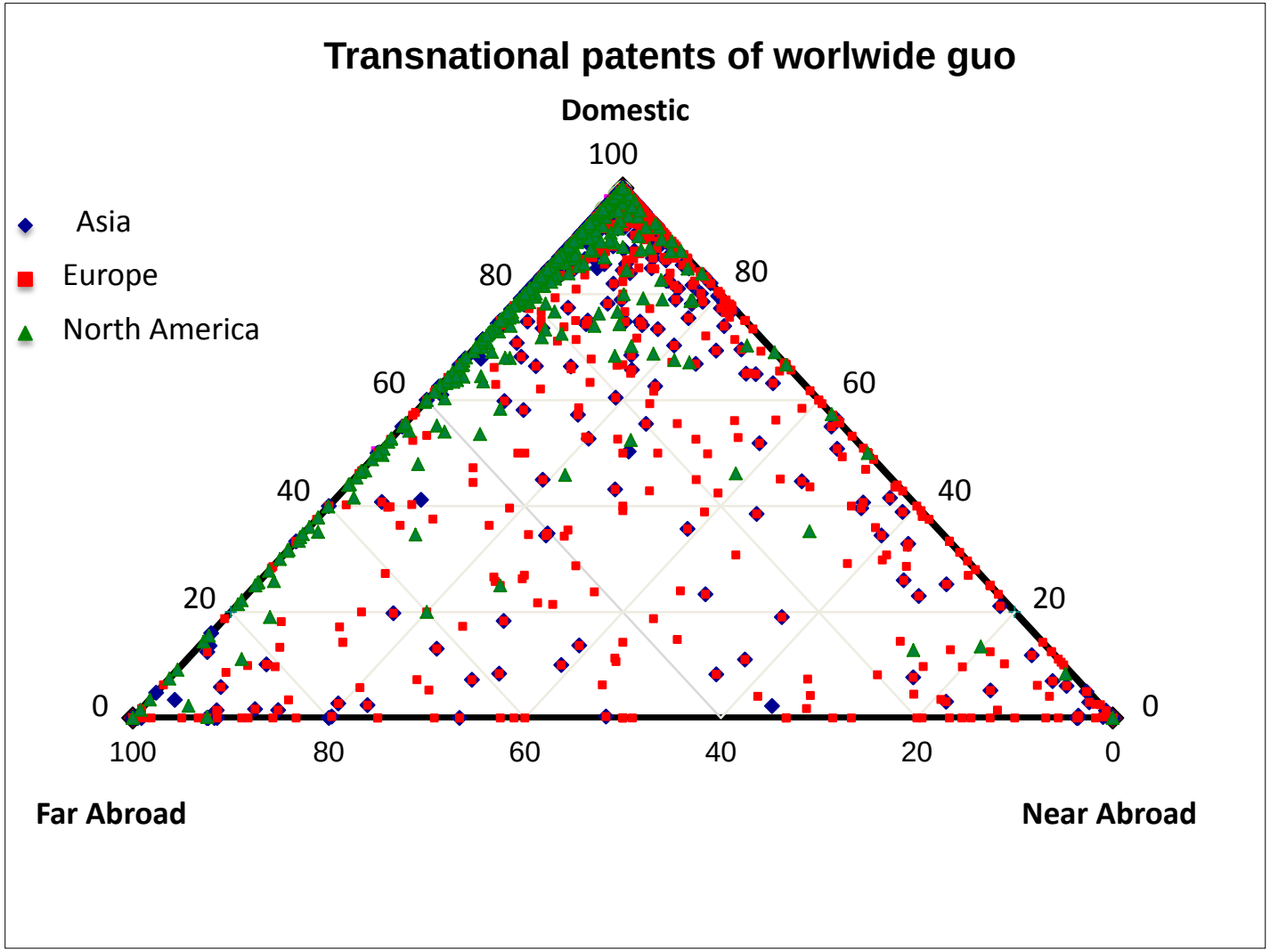


Results

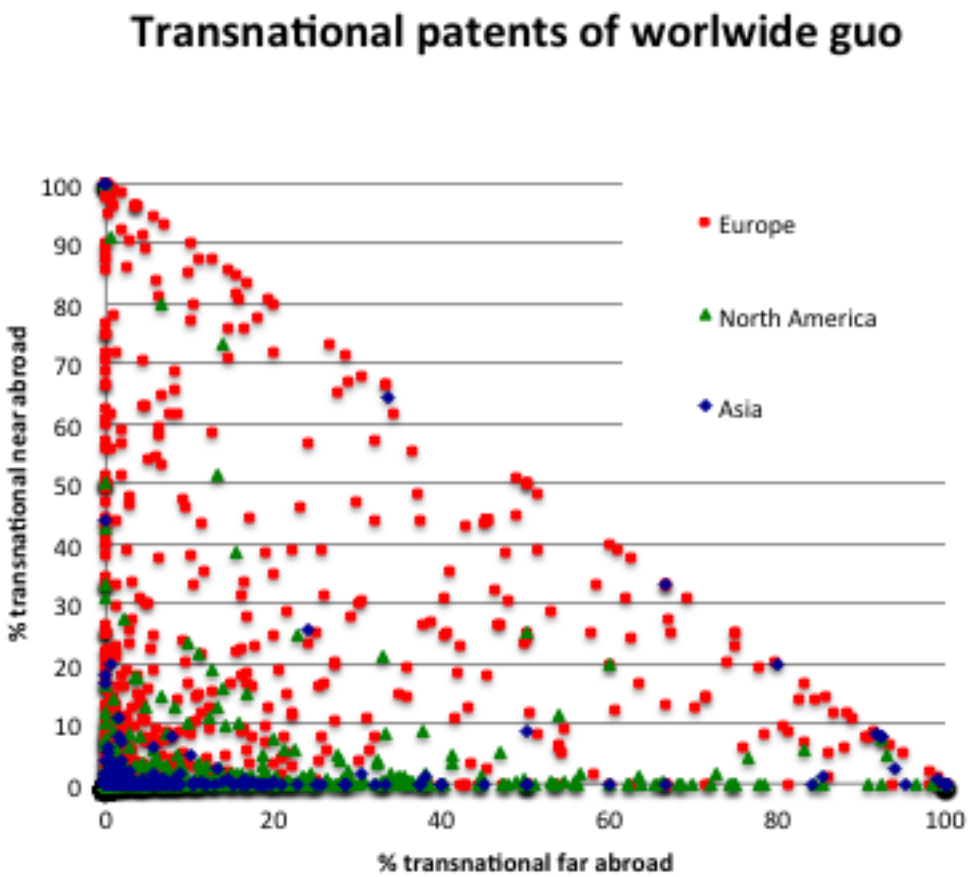
Transnational priority patents according to GUO country



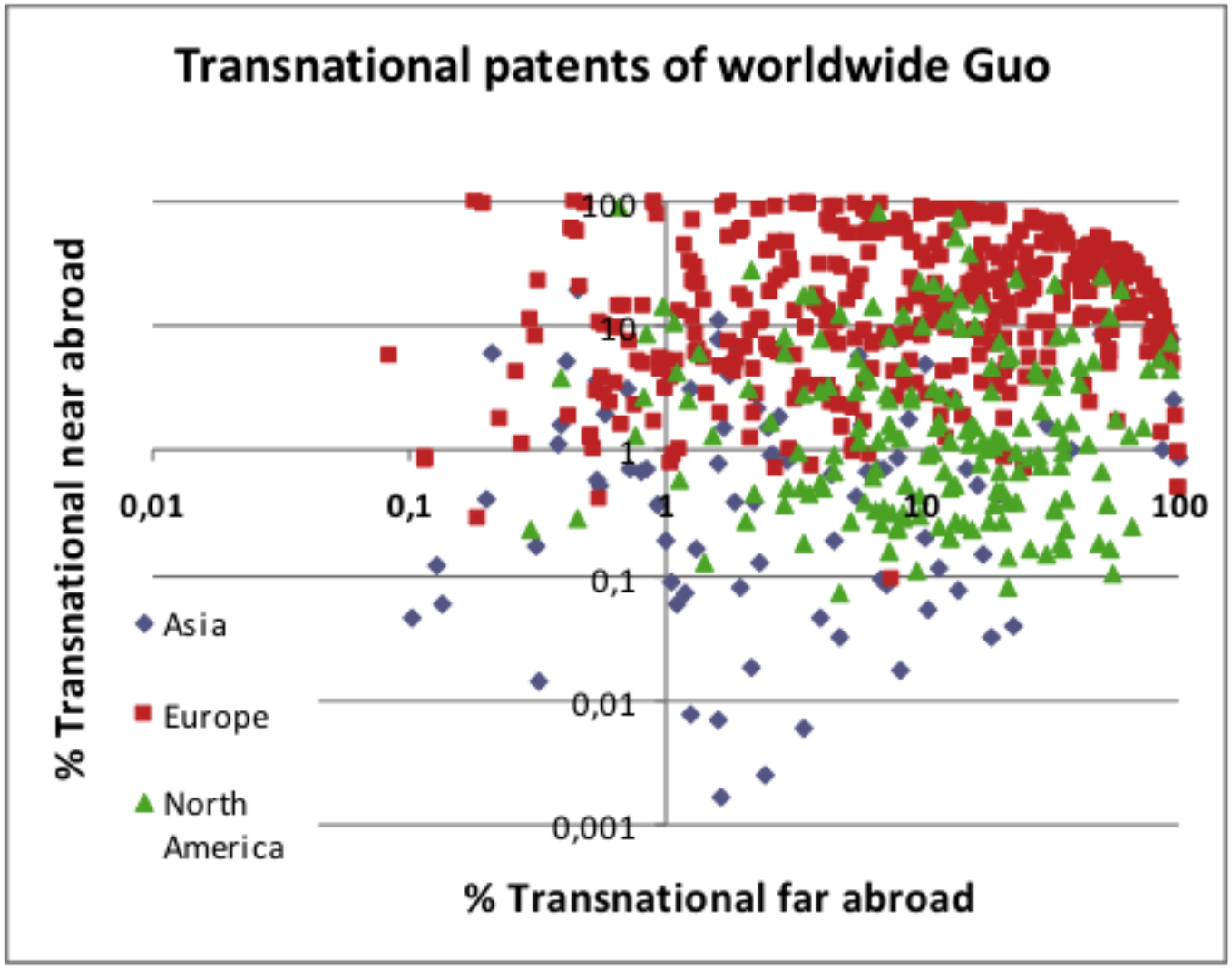
Results


Transnational patents of worlwide guo
Domestic
100
80
60
40
20
0
Asia
Europe
North America
100
80
60
40
20
0
Far Abroad
Near Abroad

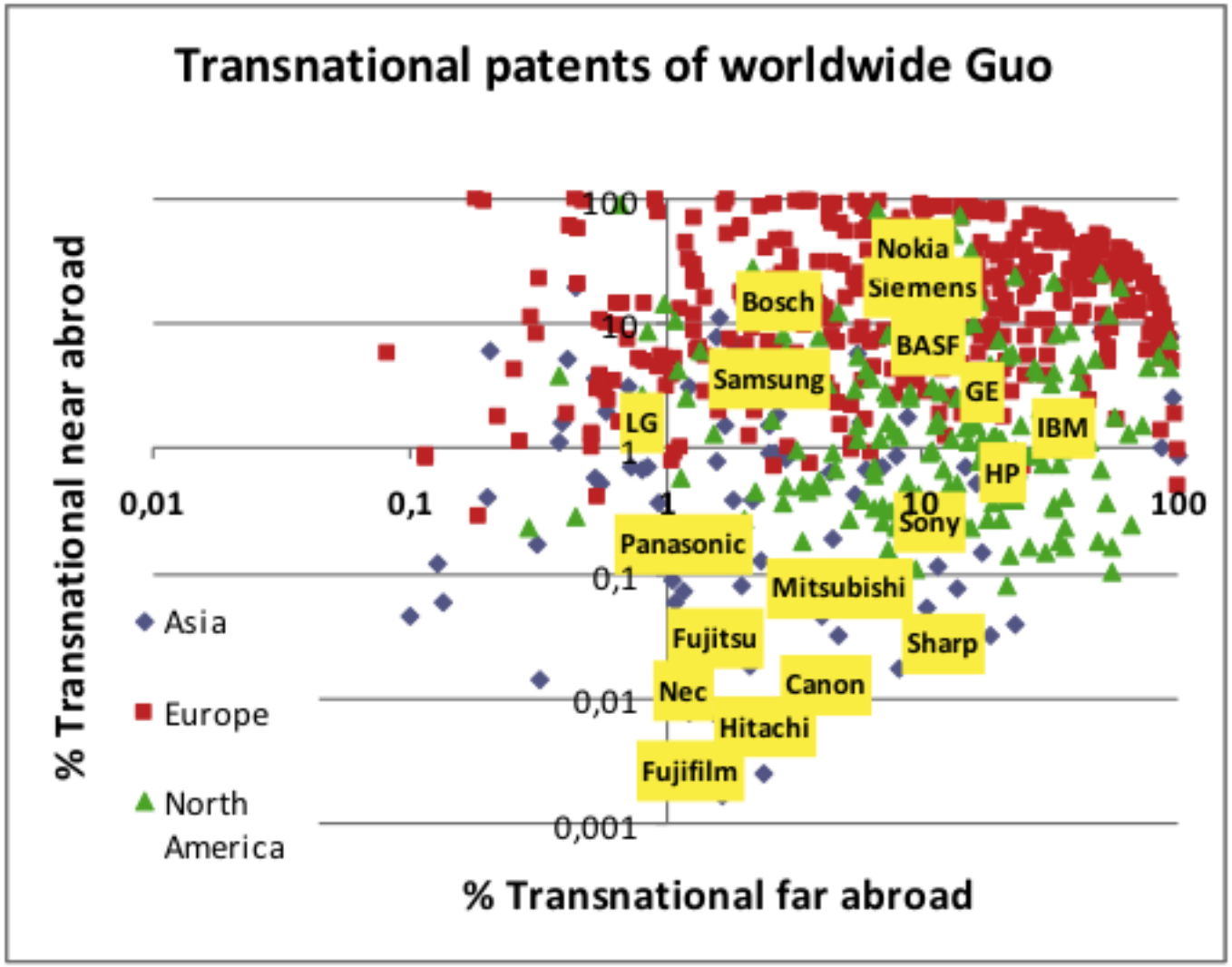
Results


Transnational patents of worlwide guo
Europe
North America
Asia
% transnational near abroad
% transnational far abroad
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100

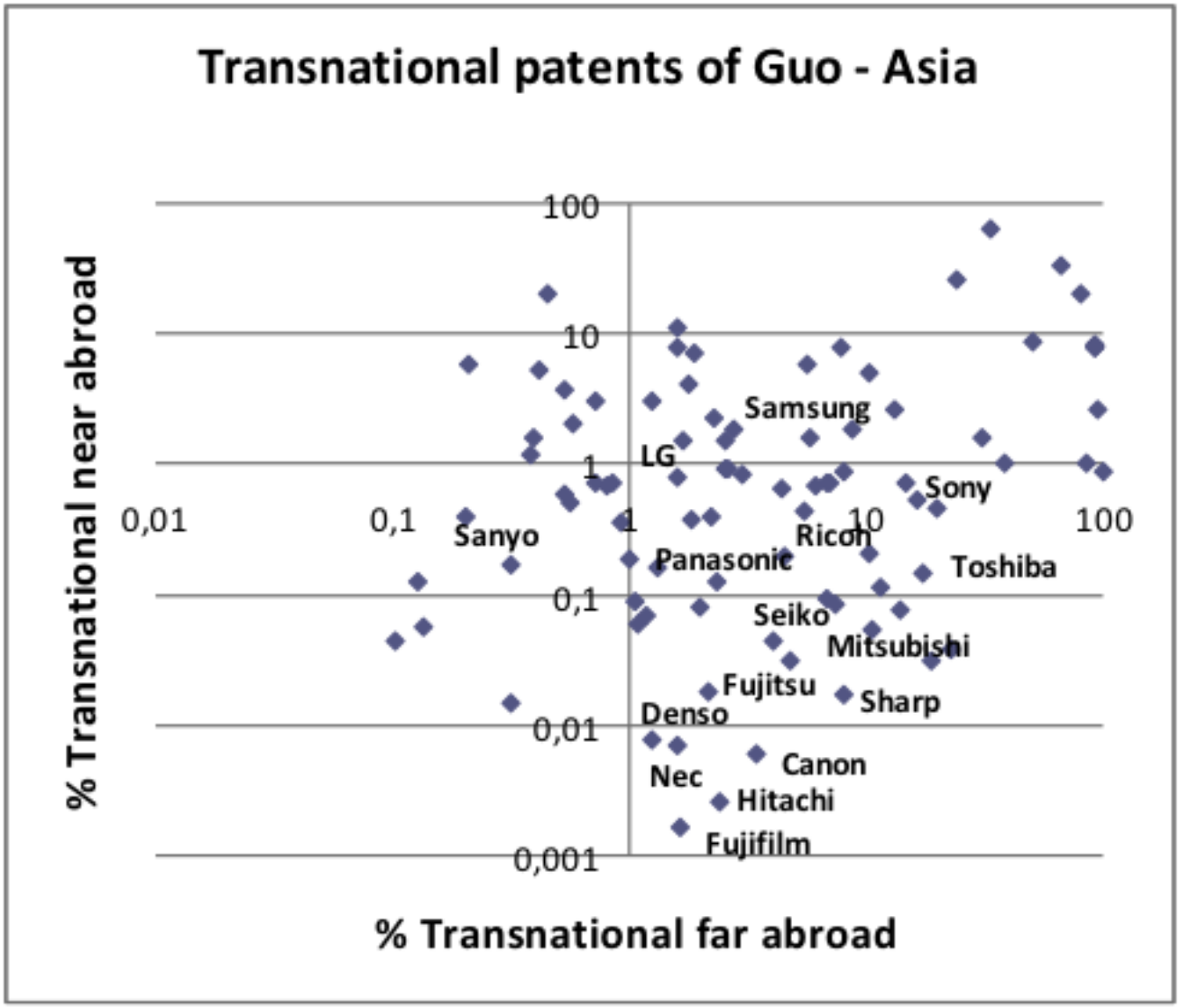
Results


Transnational patents of worldwide Guo
% Transnational near abroad
% Transnational far abroad
100
10
1
0,1
0,01
0,001
0,01
0,1
1
10
100
Asia
Europe
North America

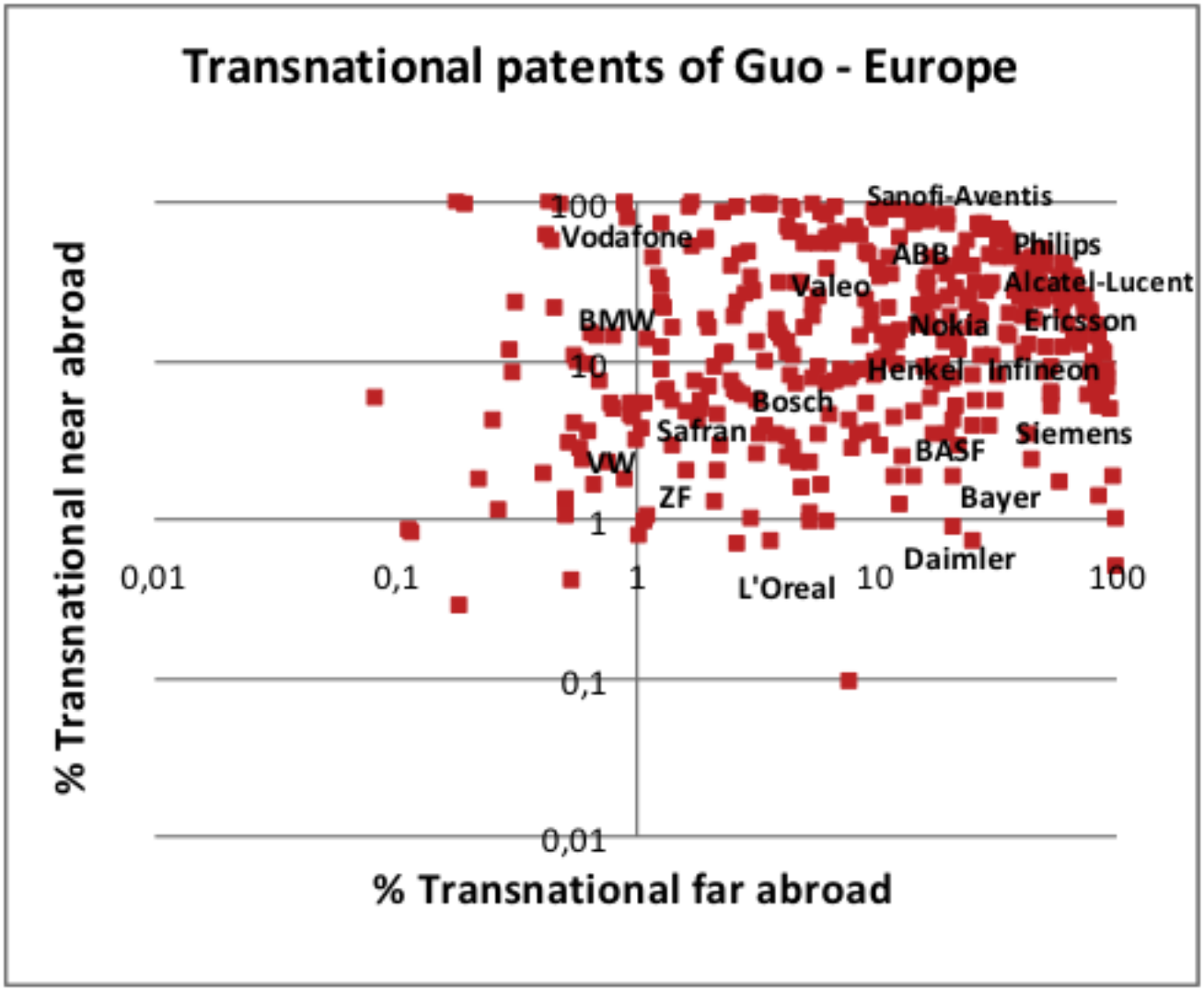
Results


Transnational patents of worldwide Guo
% Transnational near abroad
% Transnational far abroad
100
10
1
0,1
0,01
0,001
0,01
0,1
1
10
100
Nokia
Siemens
Bosch
BASF
Samsung
GE
LG
IBM
HP
Sony
Panasonic
Mitsubishi
Fujitsu
Sharp
Nec
Canon
Hitachi
Fujifilm
Asia
Europe
North America

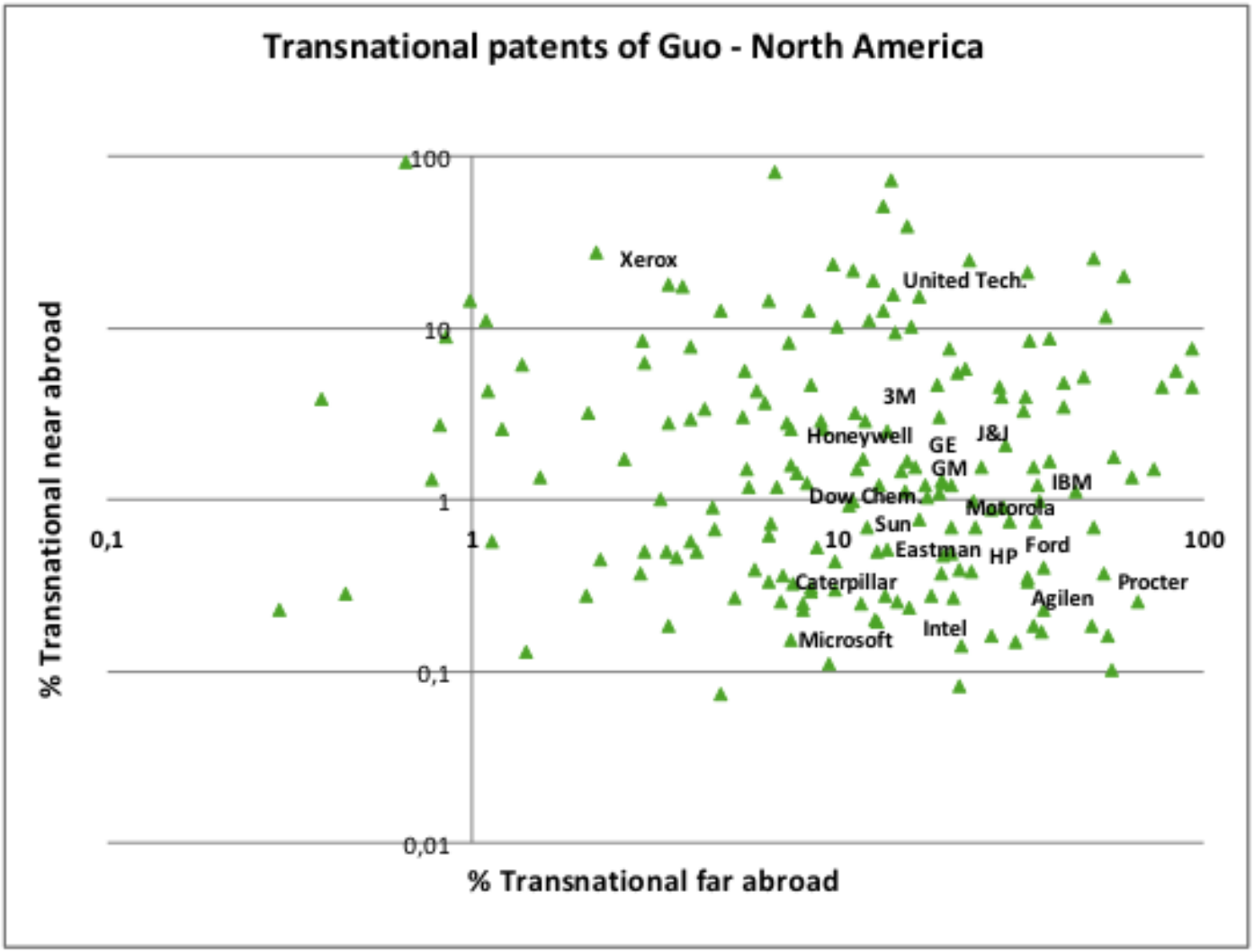
Results


Transnational patents of Guo - Asia
% Transnational near abroad
% Transnational far abroad
100
10
1
0,1
0,01
0,001
0,01
0,1
1
10
100
Samsung
LG
Sony
Sanyo
Ricoh
Panasonic
Toshiba
Seiko
Mitsubishi
Fujitsu
Sharp
Denso
Canon
Nec
Hitachi
Fujifilm

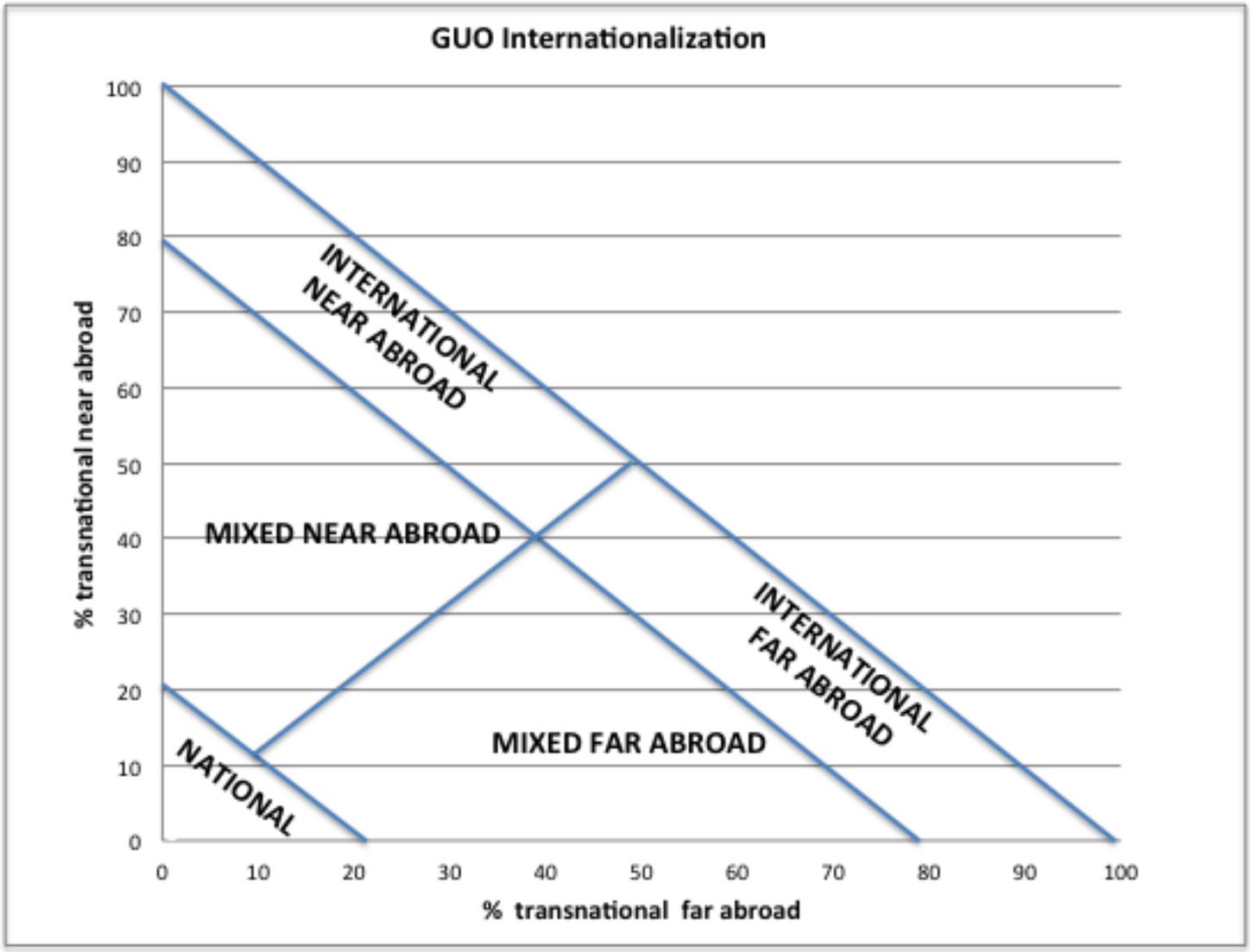
Results


Transnational patents of Guo - Europe
% Transnational near abroad
% Transnational far abroad
100
10
1
0,1
0,01
0,01
0,1
1
10
100
Sanofi-Aventis
Vodafone
ABB
Philips
Valeo
Alcatel-Lucent
BMW
Nokia
Ericsson
Henkel
Infineon
Bosch
Safran
Siemens
BASF
VW
ZF
Bayer
Daimler
L'Oreal

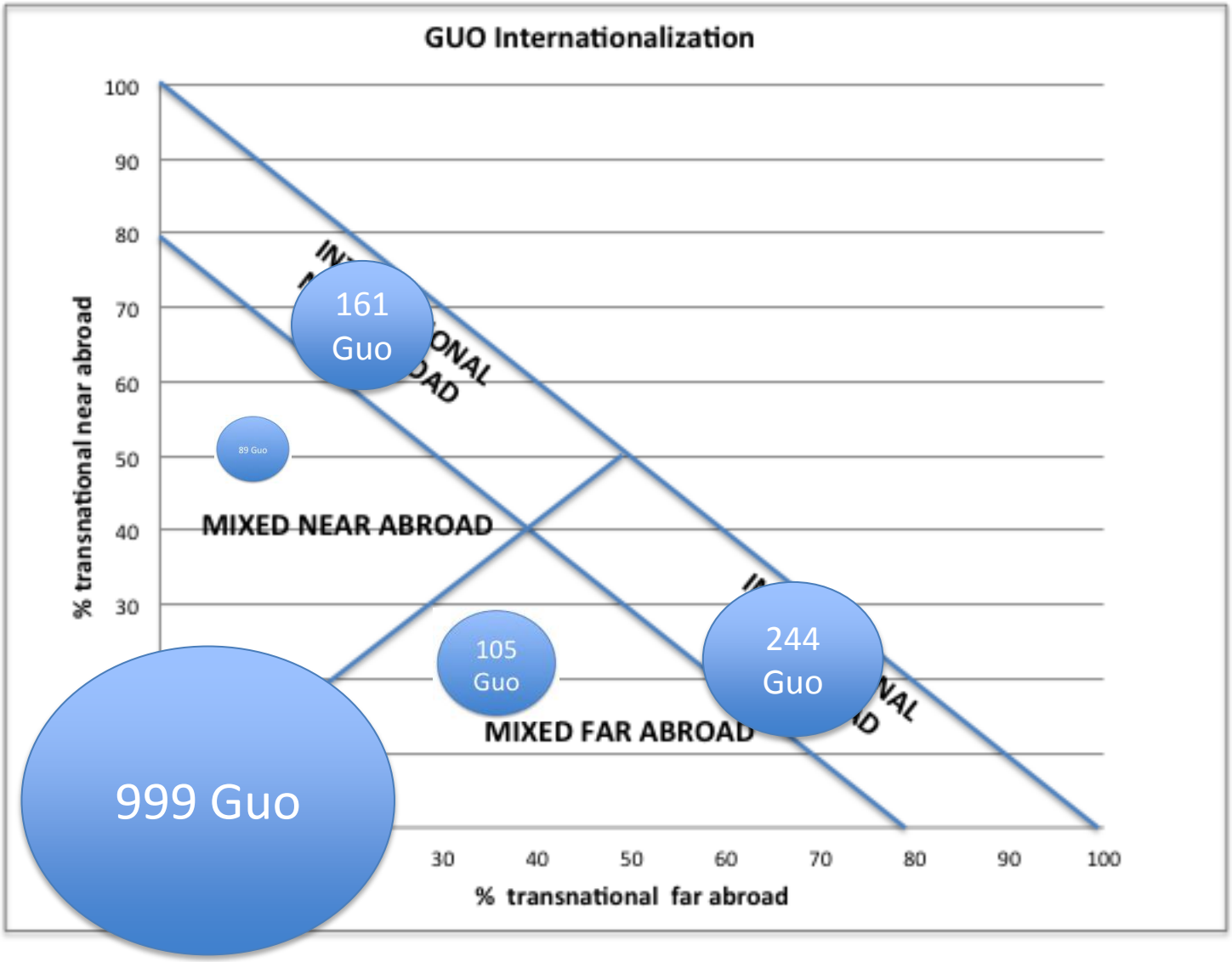
Results


Transnational patents of Guo - North America
% Transnational near abroad
% Transnational far abroad
100
10
1
0,1
0,01
0,1
1
10
100
Xerox
United Tech.
3M
Honeywell
GE
J&J
GM
IBM
Dow Chem.
Motorola
Sun
Eastman
HP
Ford
Caterpillar
Procter
Agilen
Intel
Microsoft

Results


GUO Internationalization
% transnational near abroad
% transnational far abroad
0
10
20
30
40
50
60
70
80
90
100
INTERNATIONAL NEAR ABROAD
MIXED NEAR ABROAD
INTERNATIONAL FAR ABROAD
MIXED FAR ABROAD
NATIONAL

Results


GUO Internationalization
% transnational near abroad
% transnational far abroad
100
90
80
70
60
50
40
30
30
40
50
60
70
80
90
100
161 Guo
89 Guo
MIXED NEAR ABROAD
105 Guo
MIXED FAR ABROAD
244 Guo
999 Guo

Results

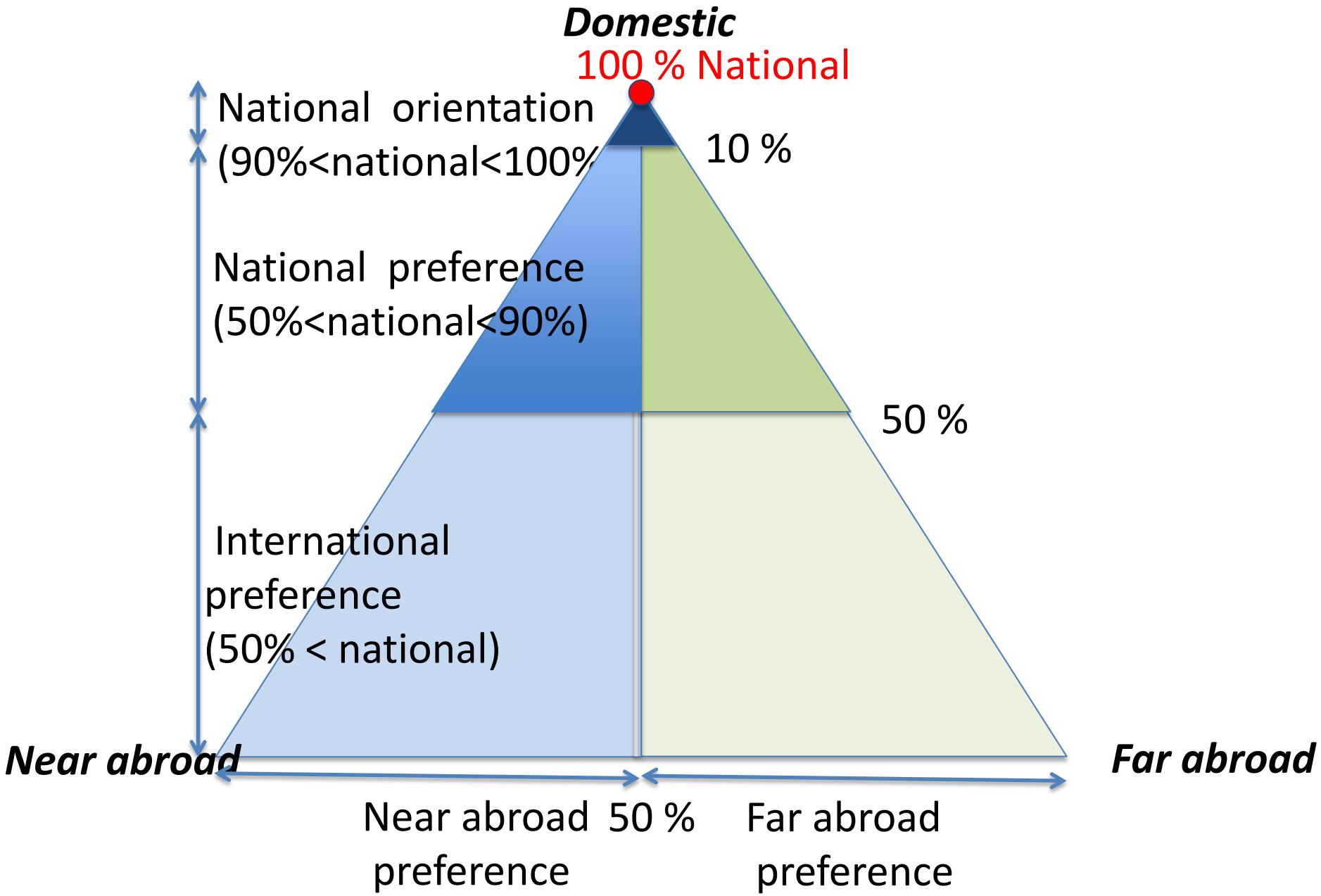
All Guo

Continent	% guo National	% guo Mixed_near abroad	% guo International _near abroad	% guo Mixed_far abroad	% guo International_ far abroad
Asia	83,50	0,76	1,02	5,58	9,14
Europe	49,20	17,55	10,51	11,99	10,75
Northern America	66,53	3,39	1,00	26,49	2,59

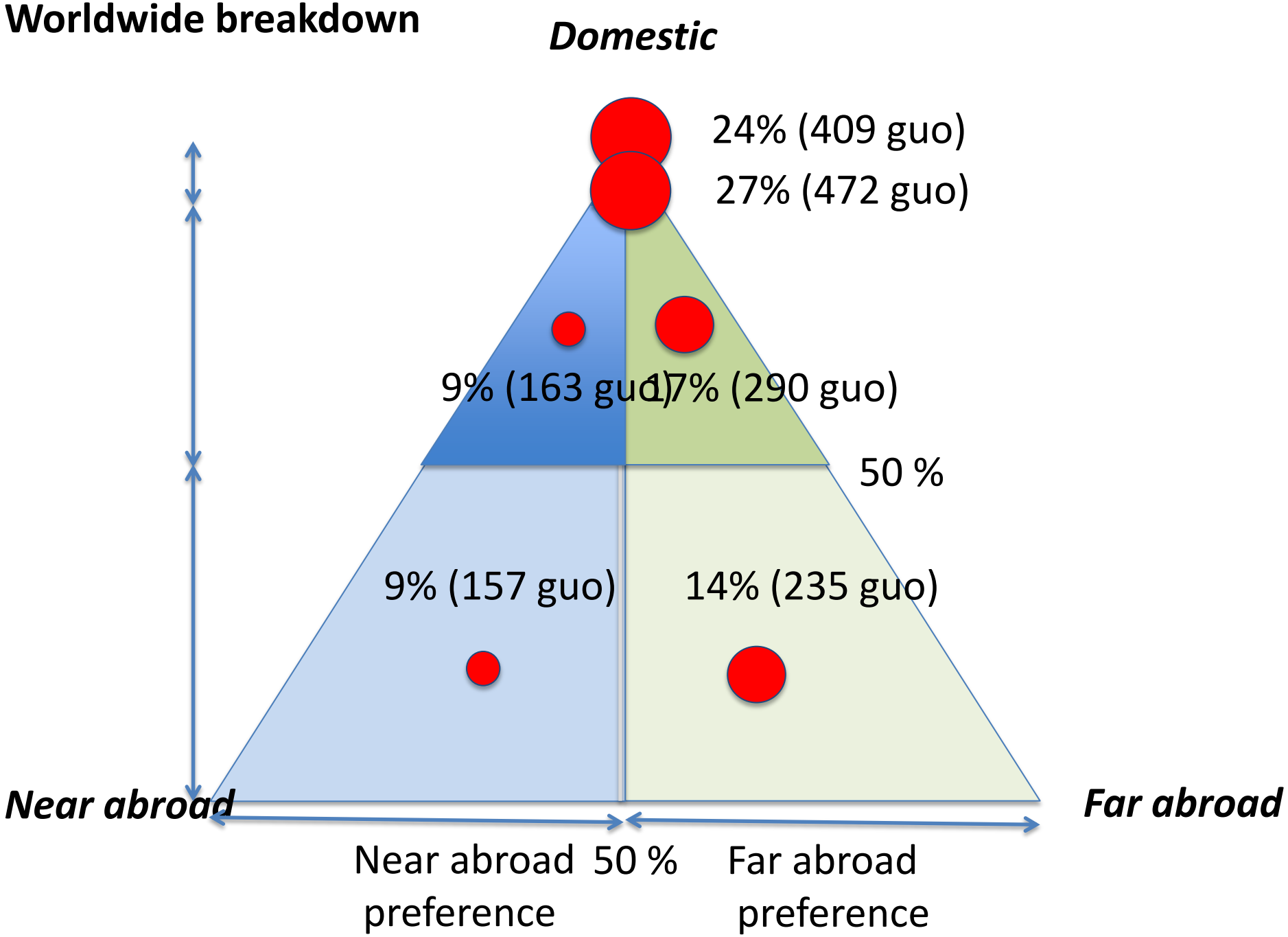
Guo (> 1 patent/year)

Continent	% guo National	% guo Mixed_near abroad	% guo International _near abroad	% guo Mixed_far abroad	% guo International _far abroad
Asia	93,36	1,05	0,35	2,80	2,45
Europe	47,10	19,29	10,58	13,90	9,13
Northern America	64,12	3,43	0,79	29,29	2,37

New thresholds towards a robust typology

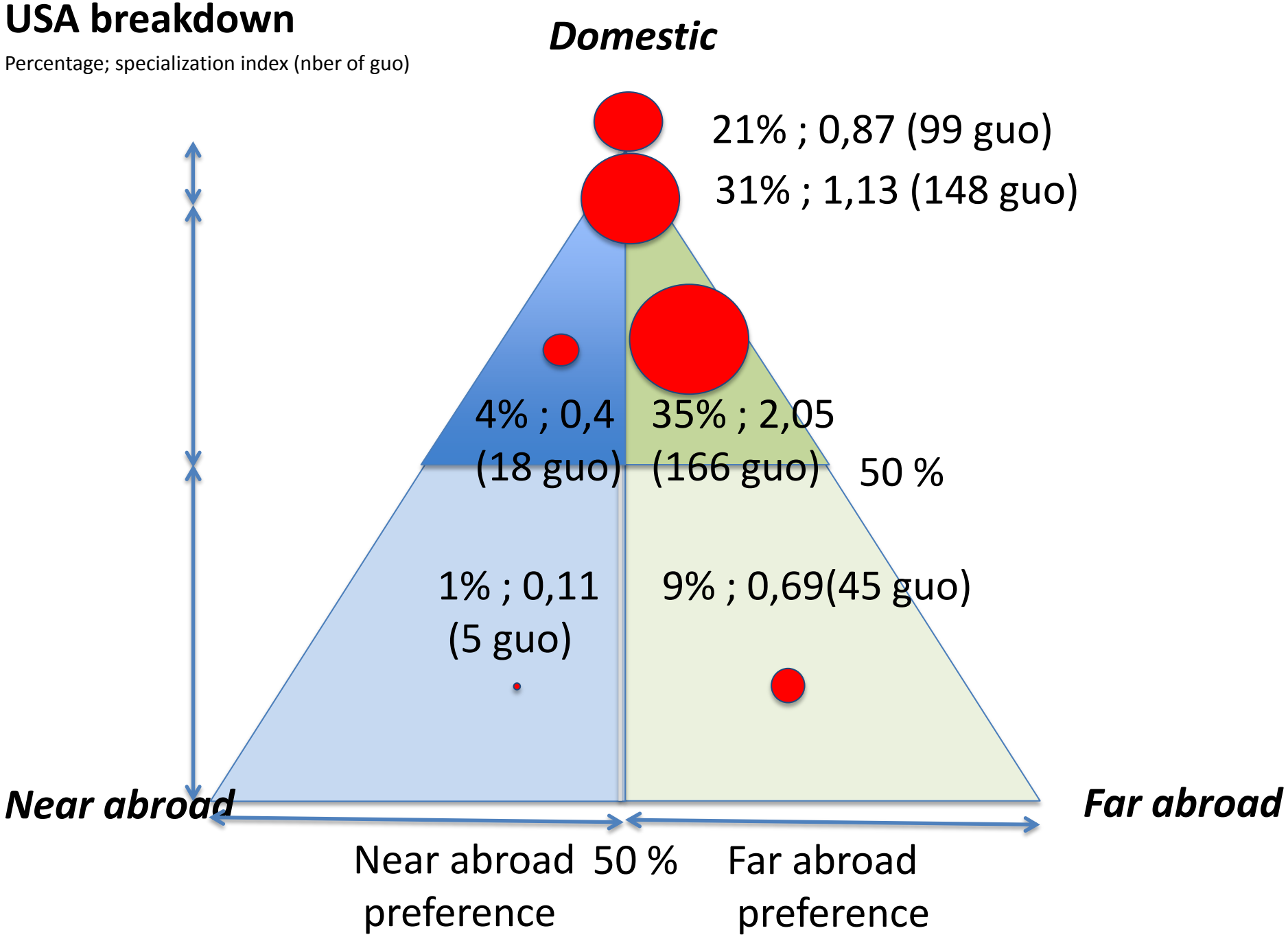


Worldwide breakdown

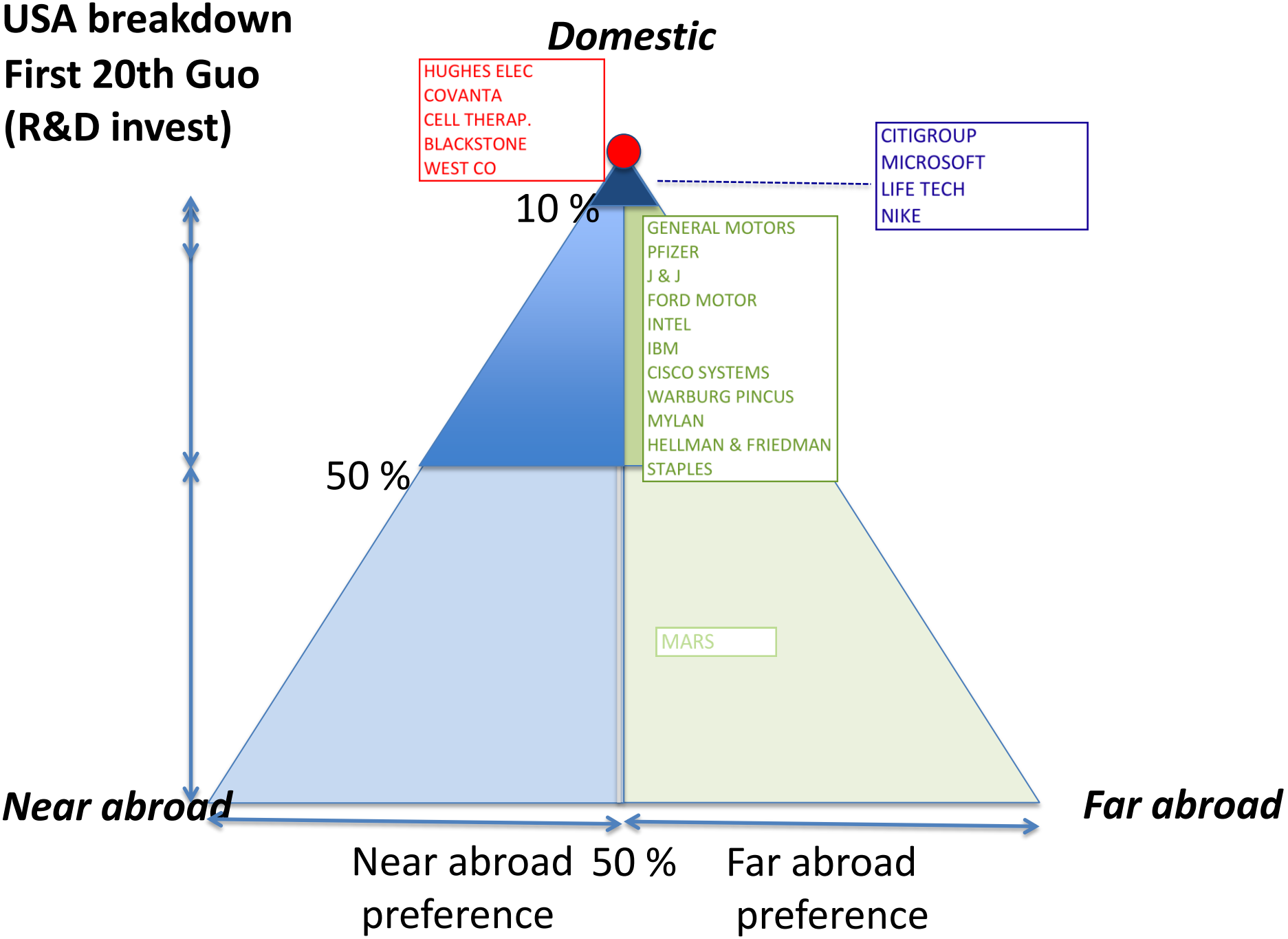


USA breakdown

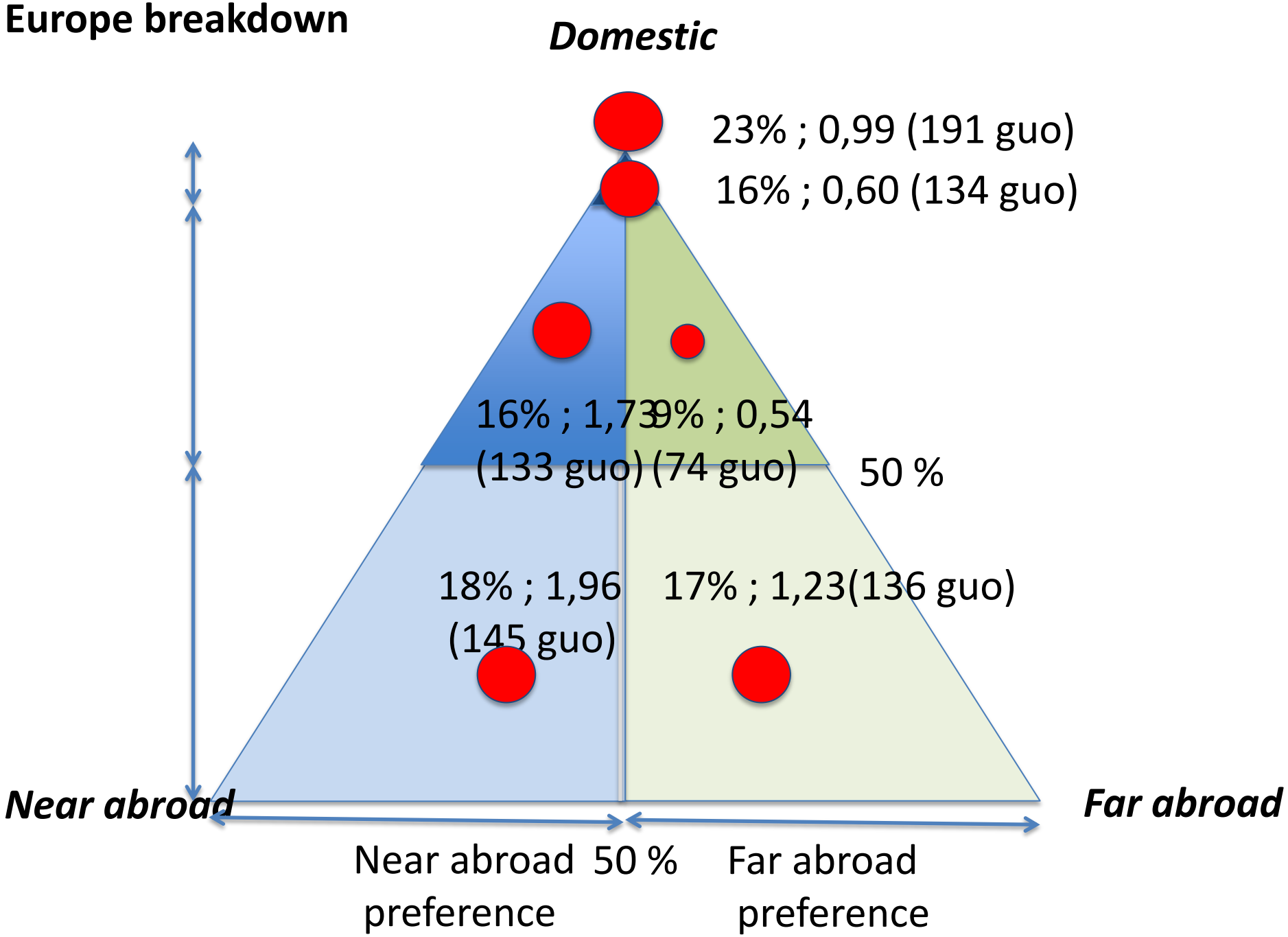
Percentage; specialization index (nber of guo)



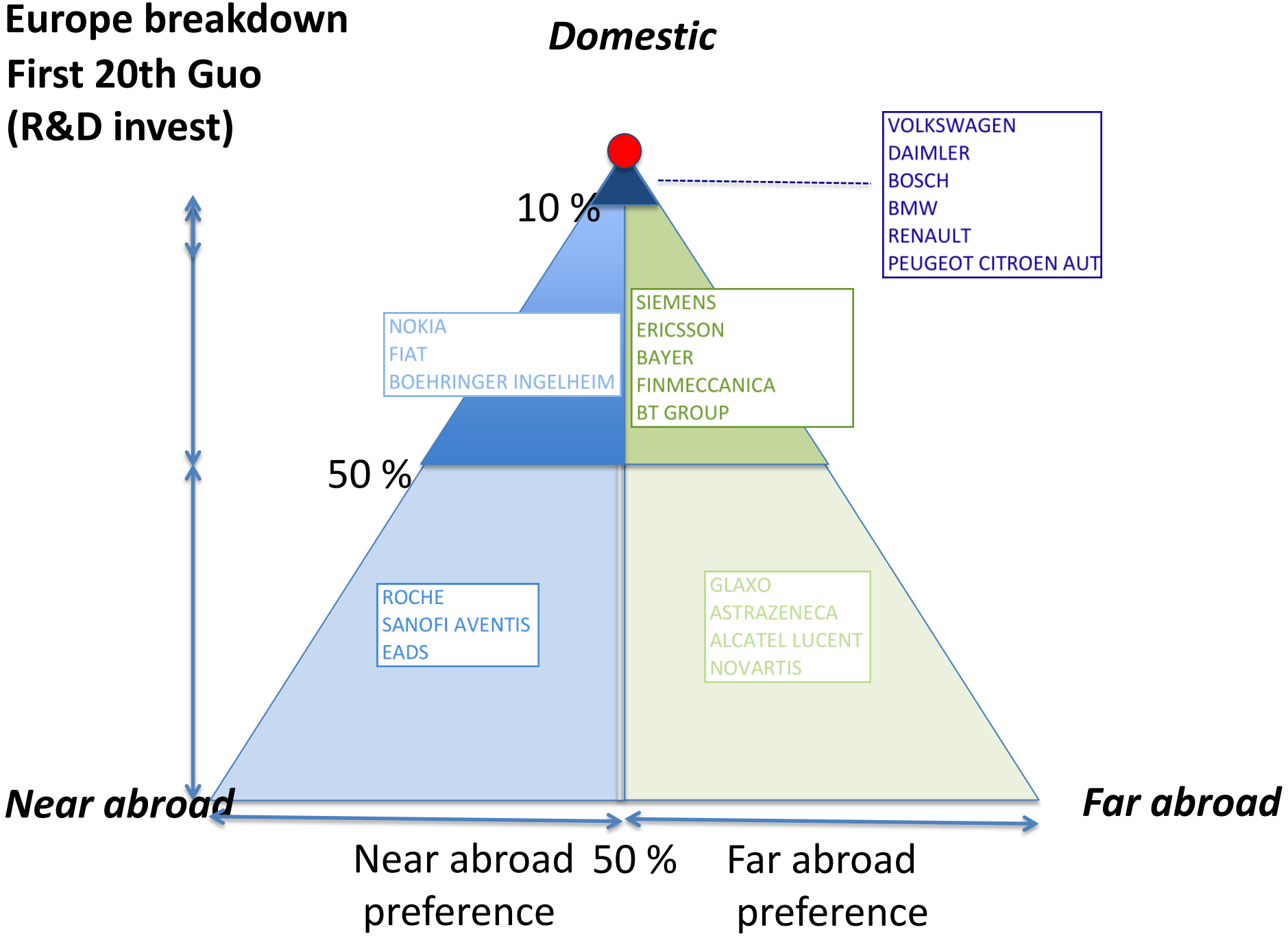
USA breakdown
First 20th Guo
(R&D invest)



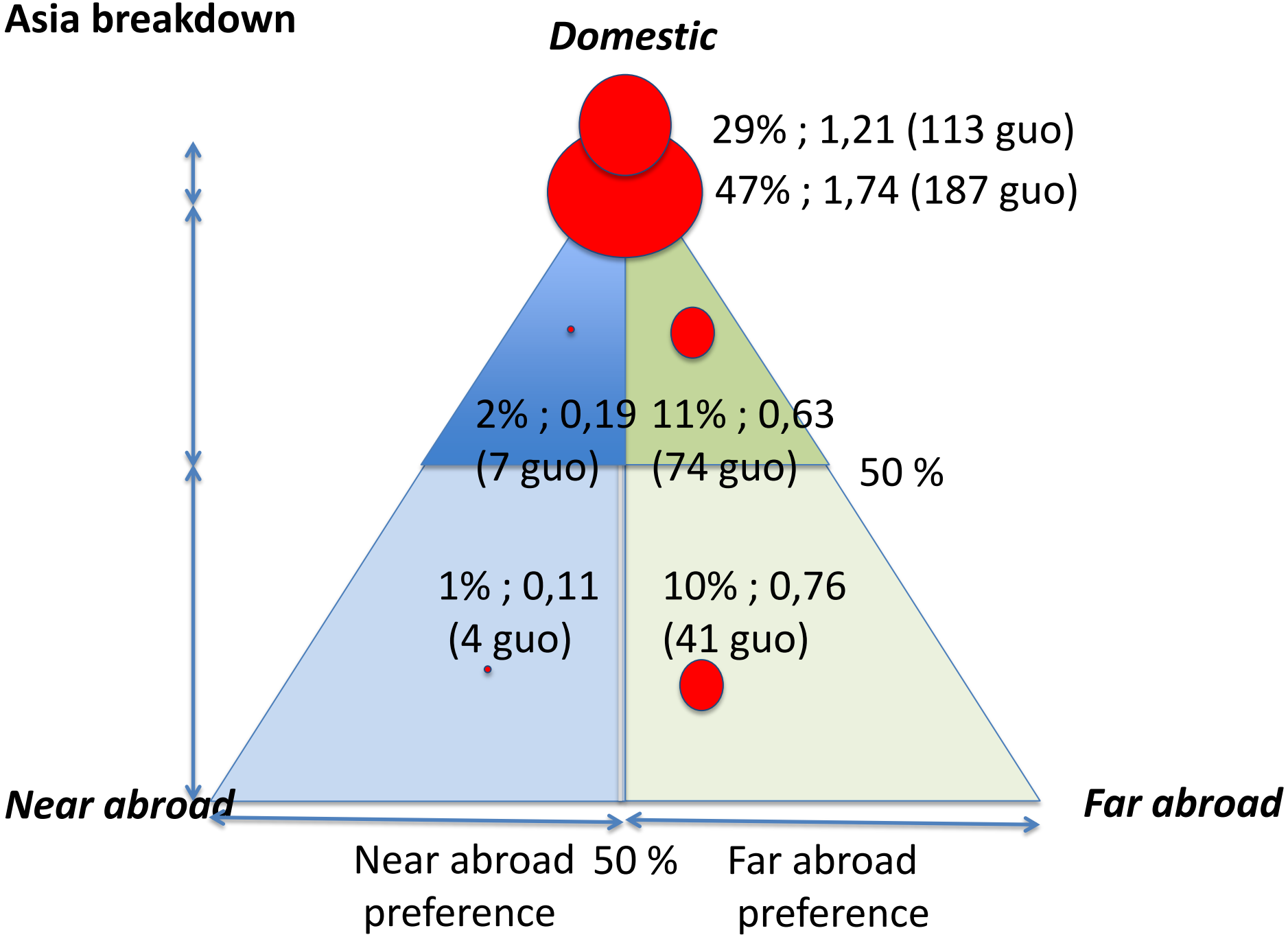
Europe breakdown



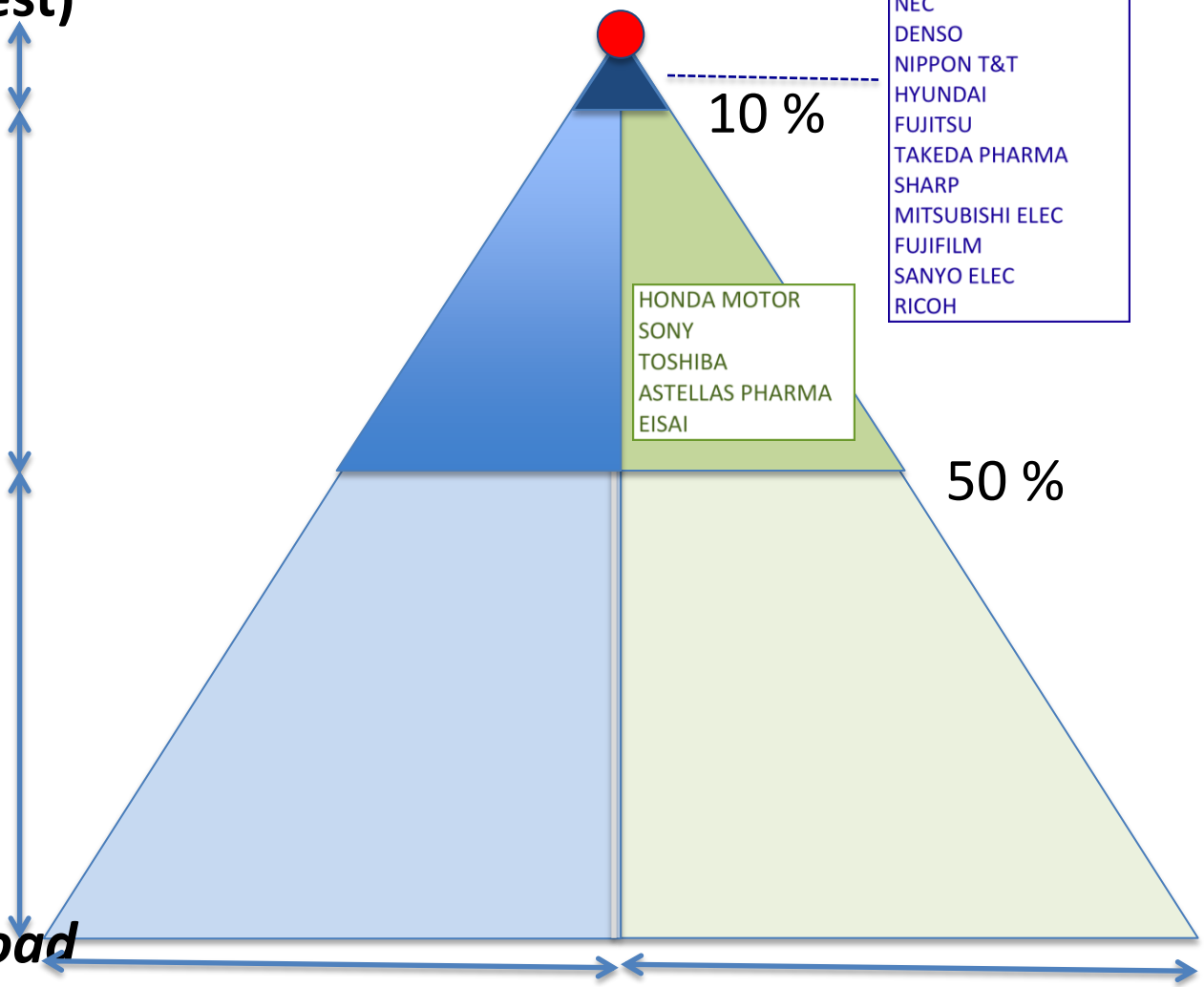
Europe breakdown
First 20th Guo
(R&D invest)



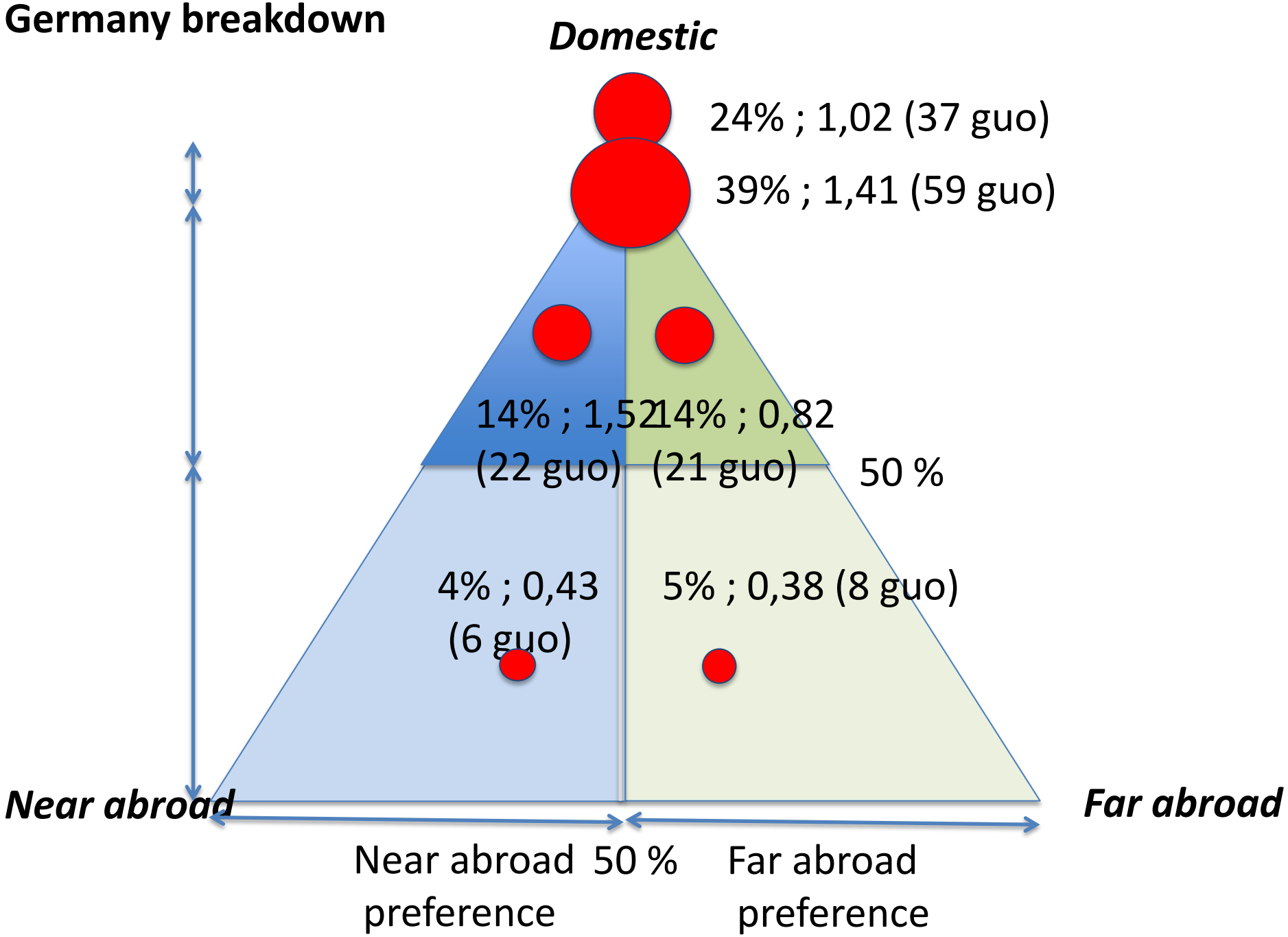
Asia breakdown



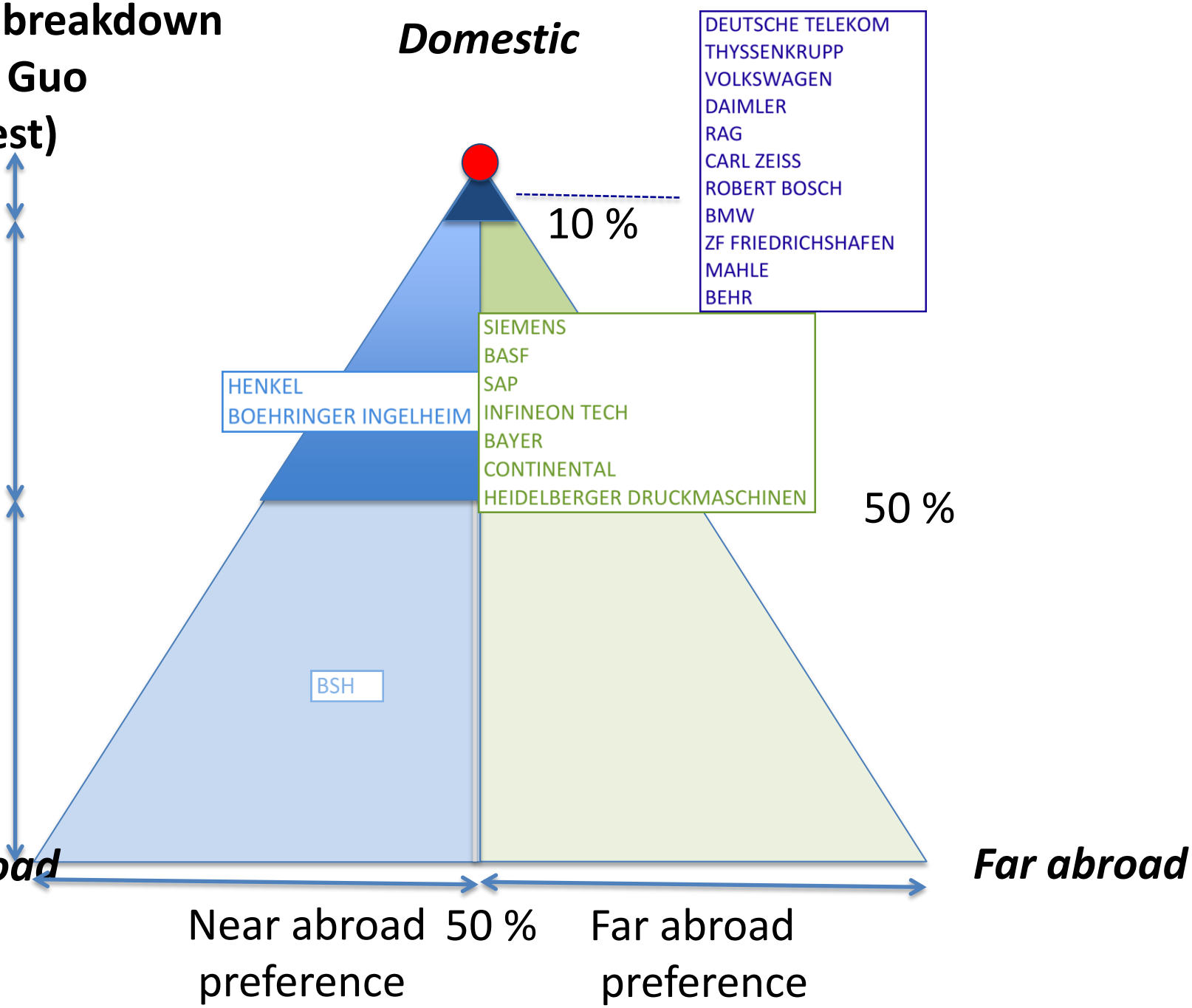
Asia breakdown
First 20th Guo
(R&D invest)



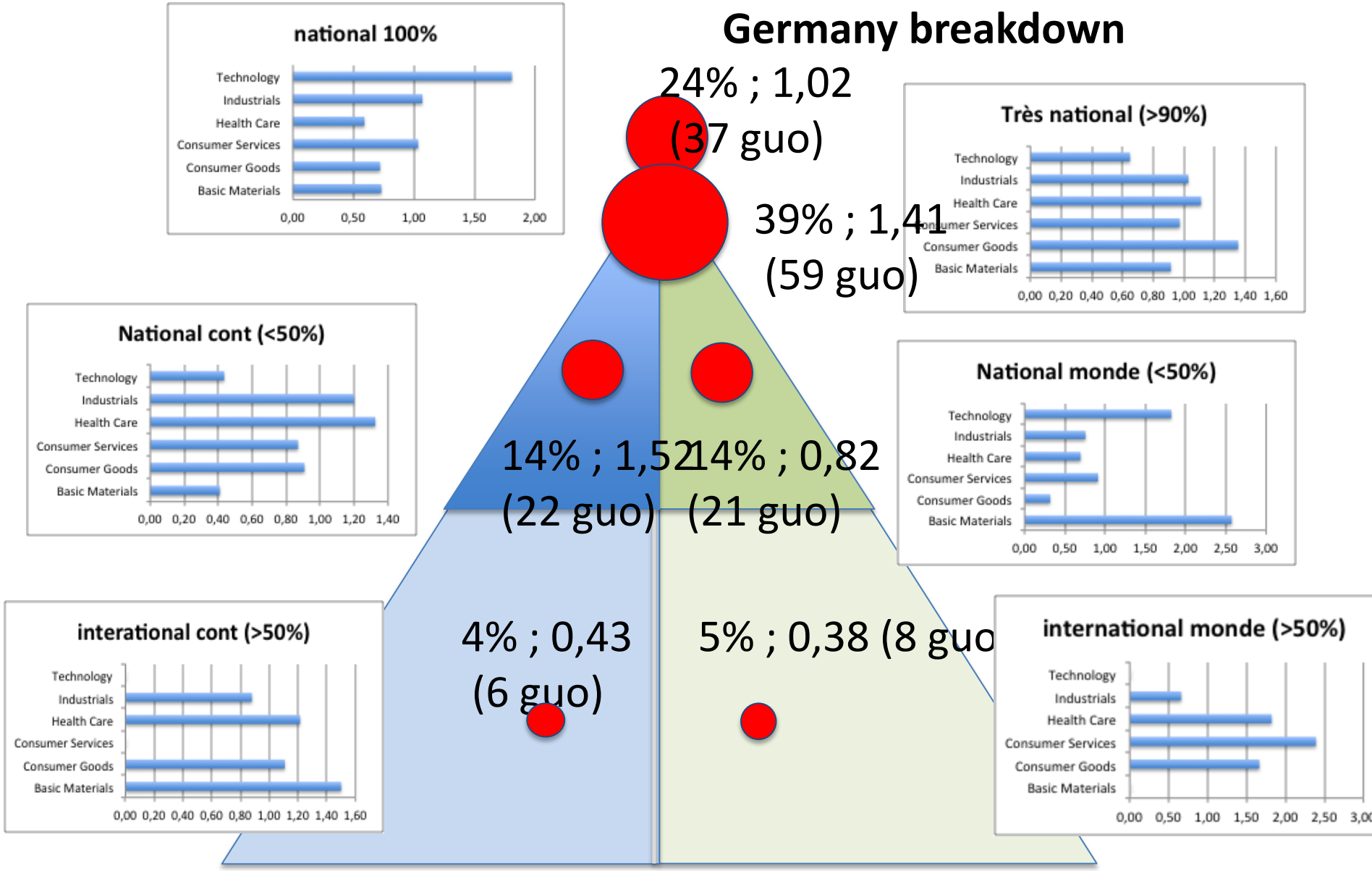
Germany breakdown



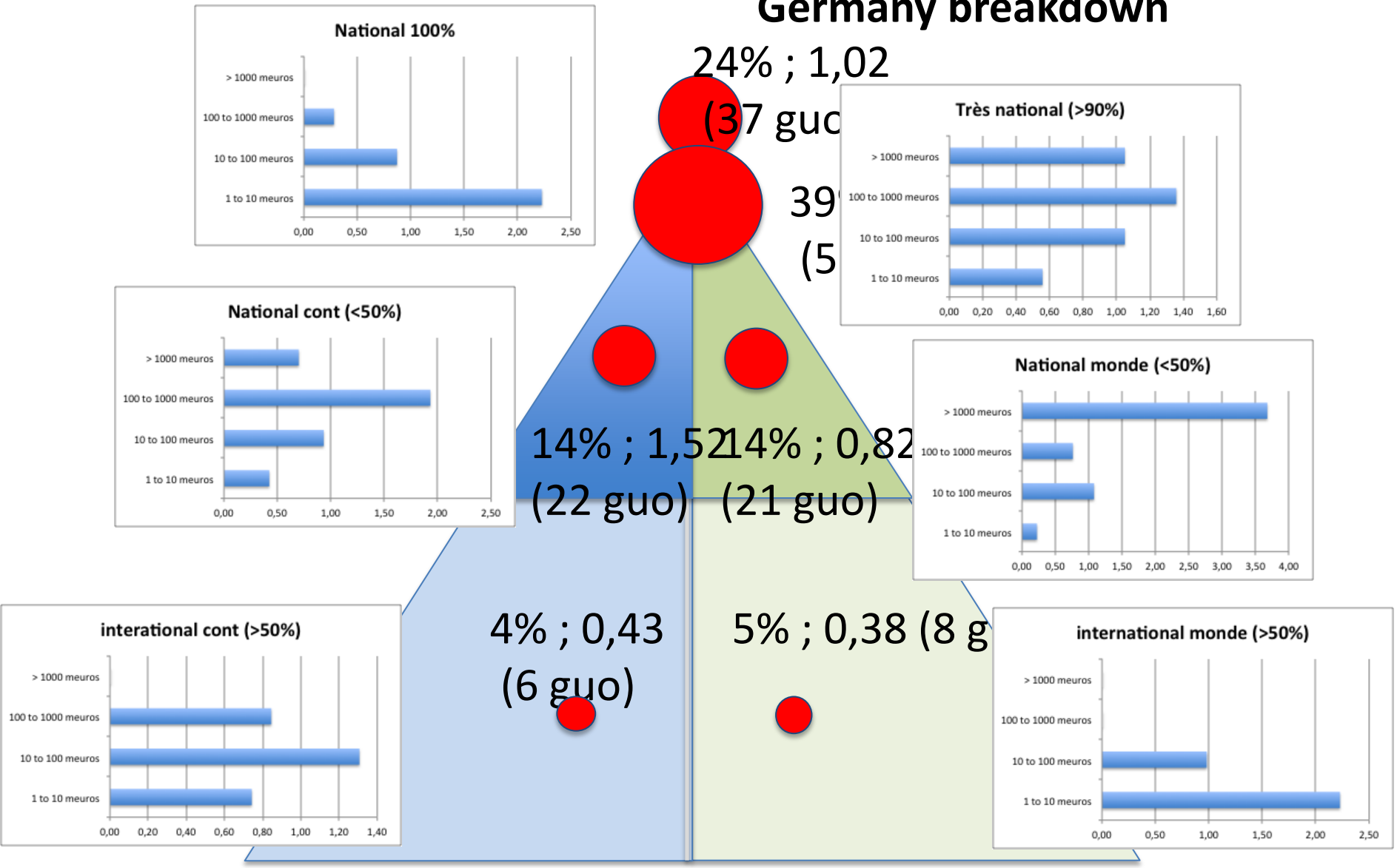
Germany breakdown First 20th Guo (R&D invest)



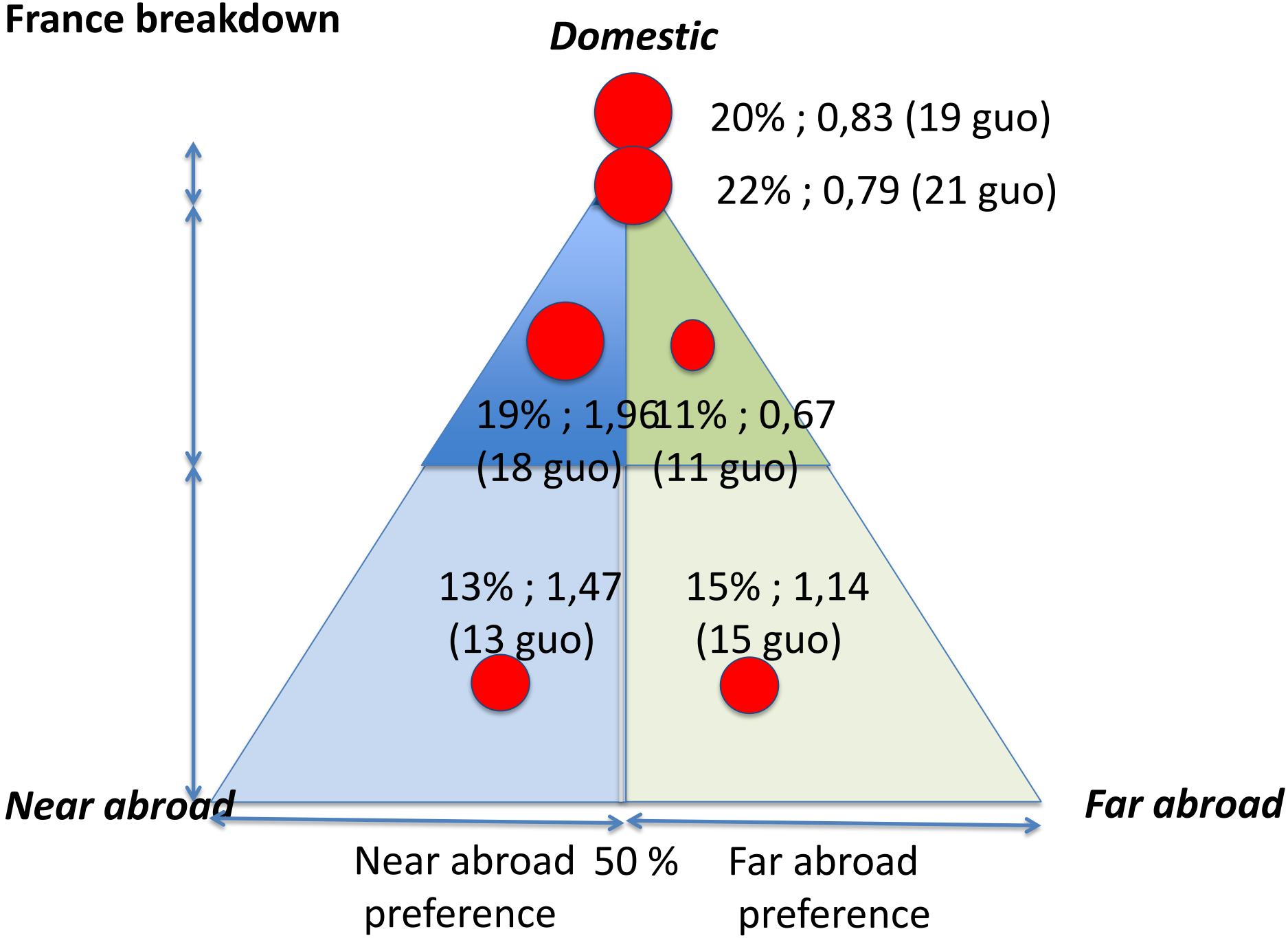
Germany breakdown



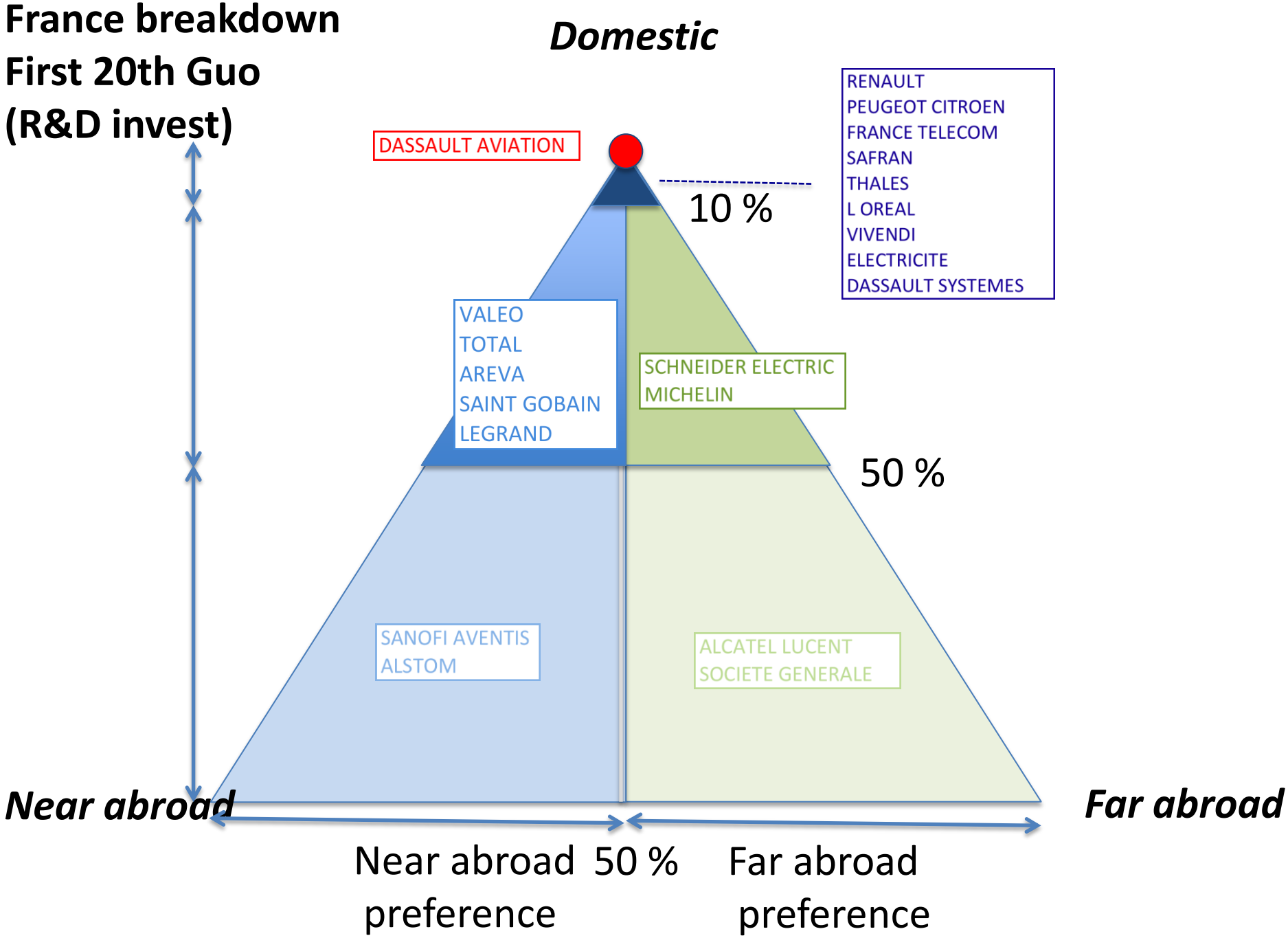
Germany breakdown



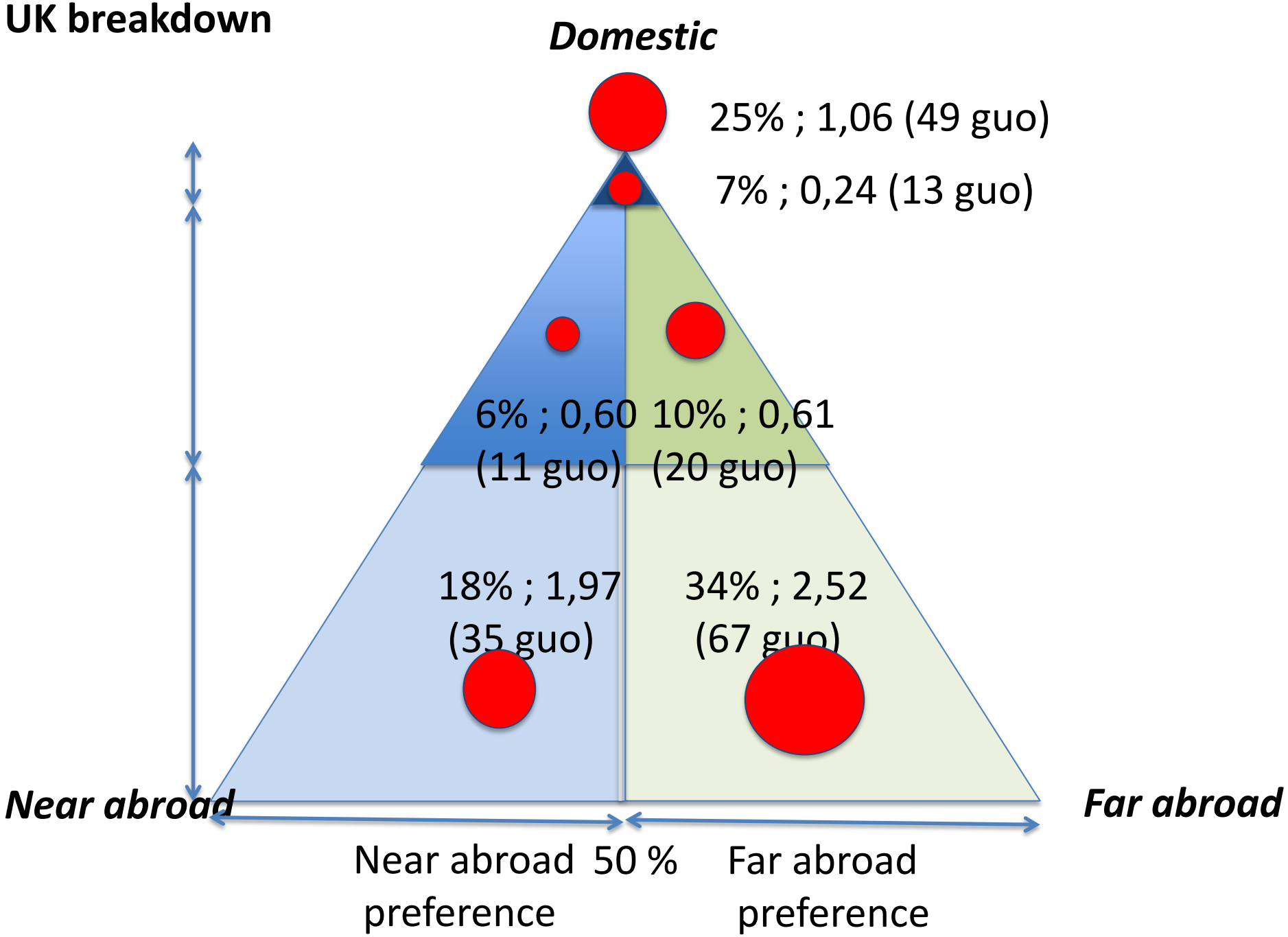
France breakdown

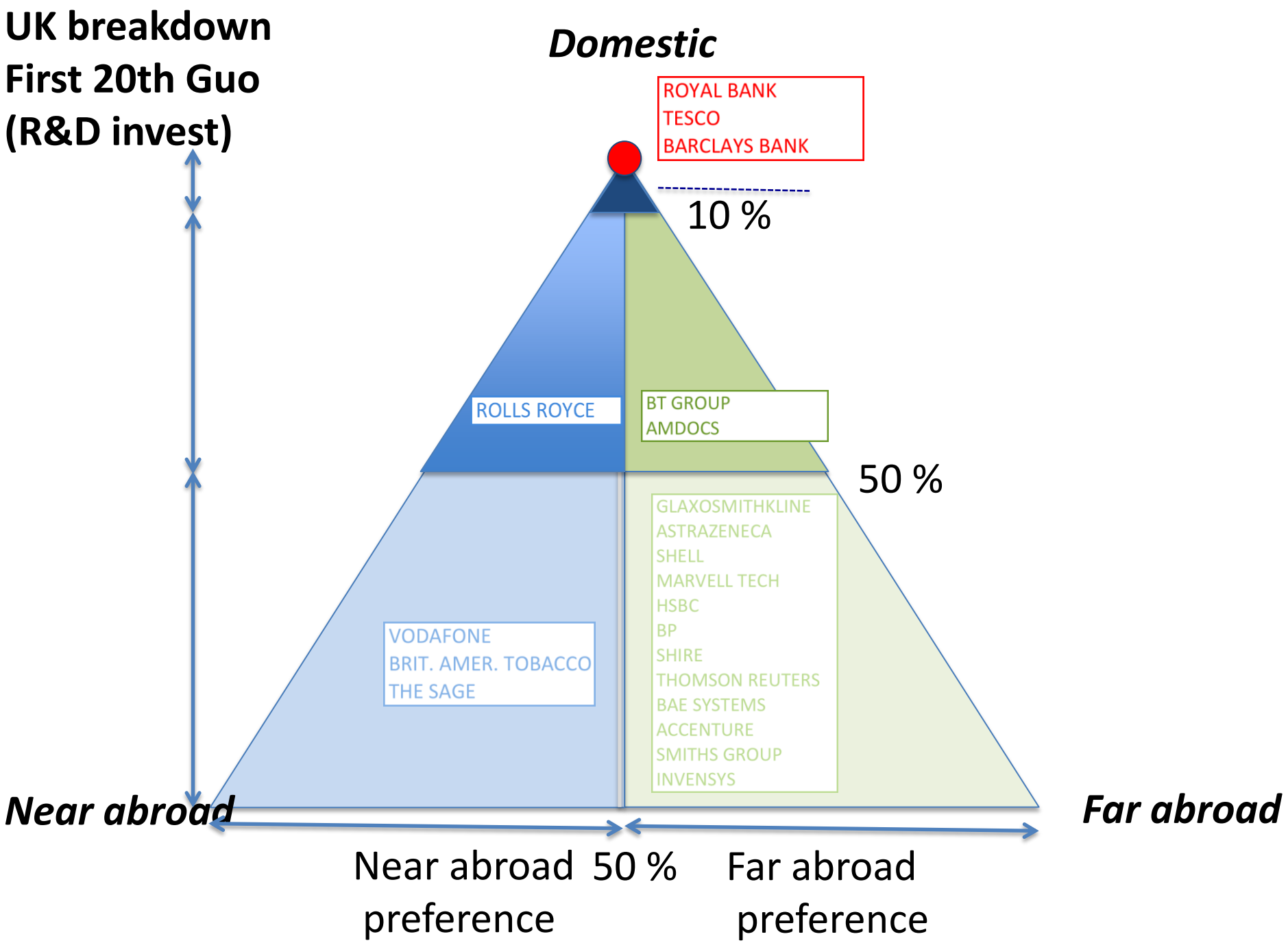


France breakdown First 20th Guo (R&D invest)



UK breakdown




UK breakdown
First 20th Guo
(R&D invest)
Domestic
ROYAL BANK
TESCO
BARCLAYS BANK
10 %
ROLLS ROYCE
BT GROUP
AMDOCS
50 %
GLAXOSMITHKLINE
ASTRAZENECA
SHELL
MARVELL TECH
HSBC
BP
SHIRE
THOMSON REUTERS
BAE SYSTEMS
ACCENTURE
SMITHS GROUP
INVENSYS
VODAFONE
BRIT. AMER. TOBACCO
THE SAGE
Near abroad
Far abroad
Near abroad preference
50 %
Far abroad preference

Specialization index	national 100%	Très national (>90%)	National cont (<50%)	Interational cont (>50%)	National monde (<50%)	international monde (>50%)
CA	0,40	0,35	2,52	1,57	1,13	1,75
US	0,87	1,13	0,40	0,11	2,05	0,69
AT	1,00	0,00	4,03	3,14	0,00	0,70
BE	0,87	0,00	1,46	4,55	0,62	1,01
CH	0,21	0,46	2,65	3,85	0,00	1,65
CZ	4,22	0,00	0,00	0,00	0,00	0,00
DE	1,02	1,41	1,52	0,43	0,82	0,38
DK	0,96	0,63	1,51	1,88	0,51	1,47
ES	0,74	1,29	1,87	3,23	0,00	0,00
FI	1,14	0,63	4,28	0,85	0,34	0,14
FR	0,83	0,79	1,96	1,47	0,67	1,14
GB	1,06	0,24	0,60	1,97	0,61	2,52
GR	2,11	0,00	0,00	2,75	0,00	1,84
HU	2,11	1,83	0,00	0,00	0,00	0,00
IE	0,00	0,00	4,54	0,00	0,85	3,15
IT	1,86	0,43	1,97	1,02	0,55	0,51
LI	0,00	0,00	0,00	10,99	0,00	0,00
LU	0,00	0,00	0,00	10,99	0,00	0,00
MT	0,00	0,00	0,00	10,99	0,00	0,00
NL	0,21	0,45	2,07	3,22	0,44	1,97
NO	0,60	1,04	6,05	0,00	0,00	0,00
PL	0,00	0,00	0,00	10,99	0,00	0,00
RU	0,00	0,00	0,00	0,00	0,00	7,34
SE	1,55	0,12	1,41	3,48	0,50	0,49
SI	0,00	0,00	0,00	10,99	0,00	0,00
CN	3,25	0,84	0,00	0,00	0,00	0,00
HK	0,00	0,00	0,00	7,33	0,00	2,45
IL	0,60	0,52	0,00	0,00	2,55	2,10
IN	1,55	0,28	0,00	0,28	0,45	3,35
JP	1,09	2,25	0,04	0,00	0,68	0,06
KR	0,84	2,68	0,71	0,00	0,00	0,00
SG	0,00	0,00	0,00	0,00	5,95	0,00
TR	4,22	0,00	0,00	0,00	0,00	0,00
TW	0,82	2,03	1,47	0,00	0,66	0,00

En grisé pays avec moins de 10 guo

Specialization index	**National 100%**	Specialization index	**Très national (>90%)**	Specialization index	**National cont (<50%)**	Specialization index	**Interational cont (>50%)**	Specialization index	**National monde (<50%)**	Specialization index	**international monde (>50%)**
US	0,87	US	1,13	CA	2,52	CA	1,57	US	2,05	CA	1,75
CA	0,40	CA	0,35	US	0,40	US	0,11	CA	1,13	US	0,69
IT	1,86	DE	1,41	FI	4,28	BE	4,55	DE	0,82	GB	2,52
SE	1,55	ES	1,29	AT	4,03	CH	3,85	FR	0,67	NL	1,97
FI	1,14	FR	0,79	CH	2,65	SE	3,48	BE	0,62	CH	1,65
GB	1,06	FI	0,63	NL	2,07	ES	3,23	GB	0,61	DK	1,47
DE	1,02	DK	0,63	IT	1,97	NL	3,22	IT	0,55	FR	1,14
AT	1,00	CH	0,46	FR	1,96	AT	3,14	DK	0,51	BE	1,01
DK	0,96	NL	0,45	ES	1,87	GB	1,97	SE	0,50	AT	0,70
BE	0,87	IT	0,43	DE	1,52	DK	1,88	NL	0,44	IT	0,51
FR	0,83	GB	0,24	DK	1,51	FR	1,47	FI	0,34	SE	0,49
ES	0,74	SE	0,12	BE	1,46	IT	1,02	AT	0,00	DE	0,38
CH	0,21	AT	0,00	SE	1,41	FI	0,85	ES	0,00	FI	0,14
NL	0,21	BE	0,00	GB	0,60	DE	0,43	CH	0,00	ES	0,00
CN	3,25	KR	2,68	TW	1,47	IN	0,28	JP	0,68	IN	3,35
IN	1,55	JP	2,25	KR	0,71	CN	0,00	TW	0,66	JP	0,06
JP	1,09	TW	2,03	JP	0,04	JP	0,00	IN	0,45	CN	0,00
KR	0,84	CN	0,84	CN	0,00	KR	0,00	CN	0,00	KR	0,00
TW	0,82	IN	0,28	IN	0,00	TW	0,00	KR	0,00	TW	0,00

Prelimenary conclusions

- The first data compilation performed within the Corporate Invention Board project has demonstrated the feasibility of combining financial and patent data on a large-scale for characterising corporate technological strategies.
- In order to study globalisation of corporate invention, there is clear need for disaggregating invention processes into their distinct and localised characteristics.
- The general trend identified in this paper is a large increase in the number of transnational priority patents in the period under study. However, the differences between countries, sectors and corporations are large.

Current work 1/3

- Use the CIB dataset with the von Zedtwitz & Gassmann's model on globalisation of corporate R&D.

Market versus technology drive in R&D internationalization: four different patterns of managing research and development

Maximilian von Zedtwitz , Oliver Gassmann, *Research Policy,* 31 (2002) 569–588

Current work 2/3

M. von Zedtwitz, O. Gassmann / Research Policy 31 (2002) 569–588

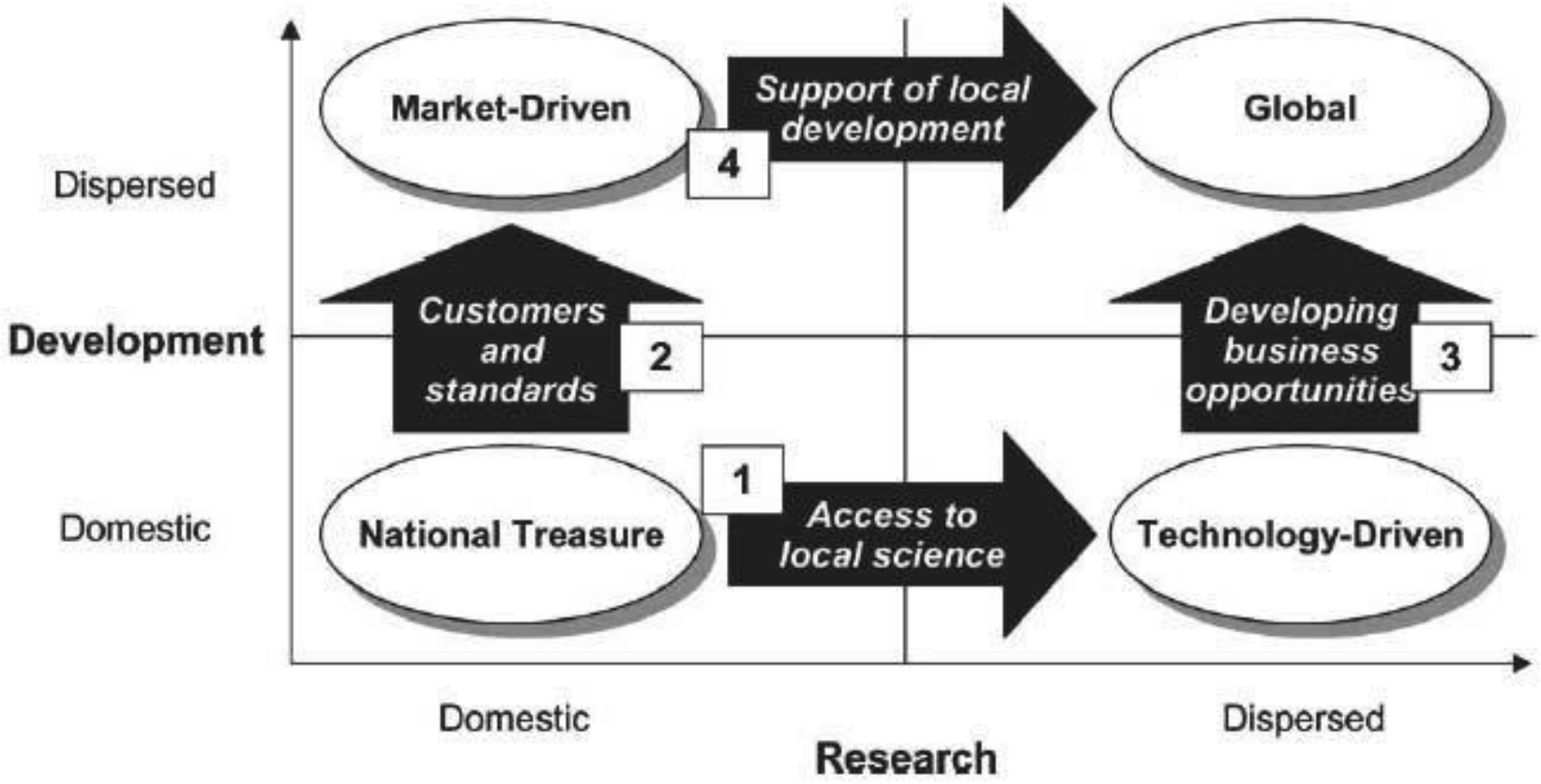


Fig. 9. Principal determinants and trends in internationalization of research and development.

Current work 3/3

How to discriminate research-based inventions *vs* development-based inventions? aka technology-driven *vs* market-driven?

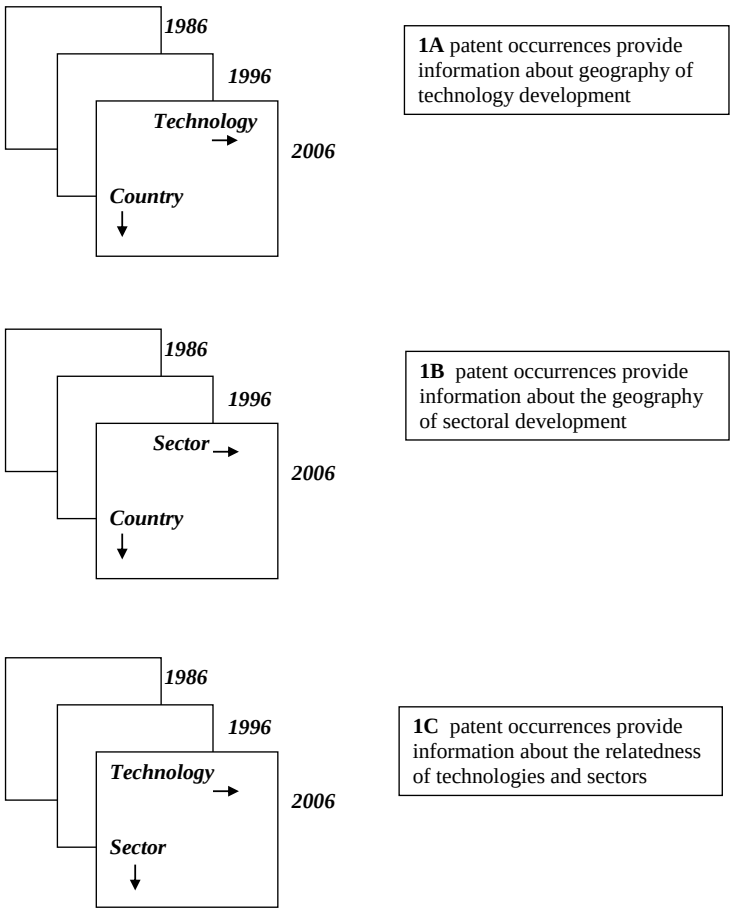
- Toplogy of patents' families. Underlying hypothesis : research-based inventions will found new families; development-based inventions will integrate existing families
- Density of scientific references within patents (aka NPLR)

Further Research 1/4

- Investigating the issue of industrial R&D production function using robust non parametric econometric methods where inputs are R&D investments and outputs are transational priority patents (with Andrea Bonaccorsi).

Further Research 2/4

- In order to study the patterns of development, we are interested in the emergence of patterns (in time) in the three dimensions of i) geography, ii) technology, and iii) sectoral (economical) dynamics, to draw conclusions about the co-evolutionary dynamics.



Further Research 3/4

- Using patent occurrences along the dimensions of countries, technologies and sectors, entropy analysis can be used to quantify the relationship between these three dimensions.
- In the model above, the entropy value of each two-dimensional matrix is given by;

$$H(A) = -\sum_{a=A} \left(pa \cdot \log_2 pa \right)$$

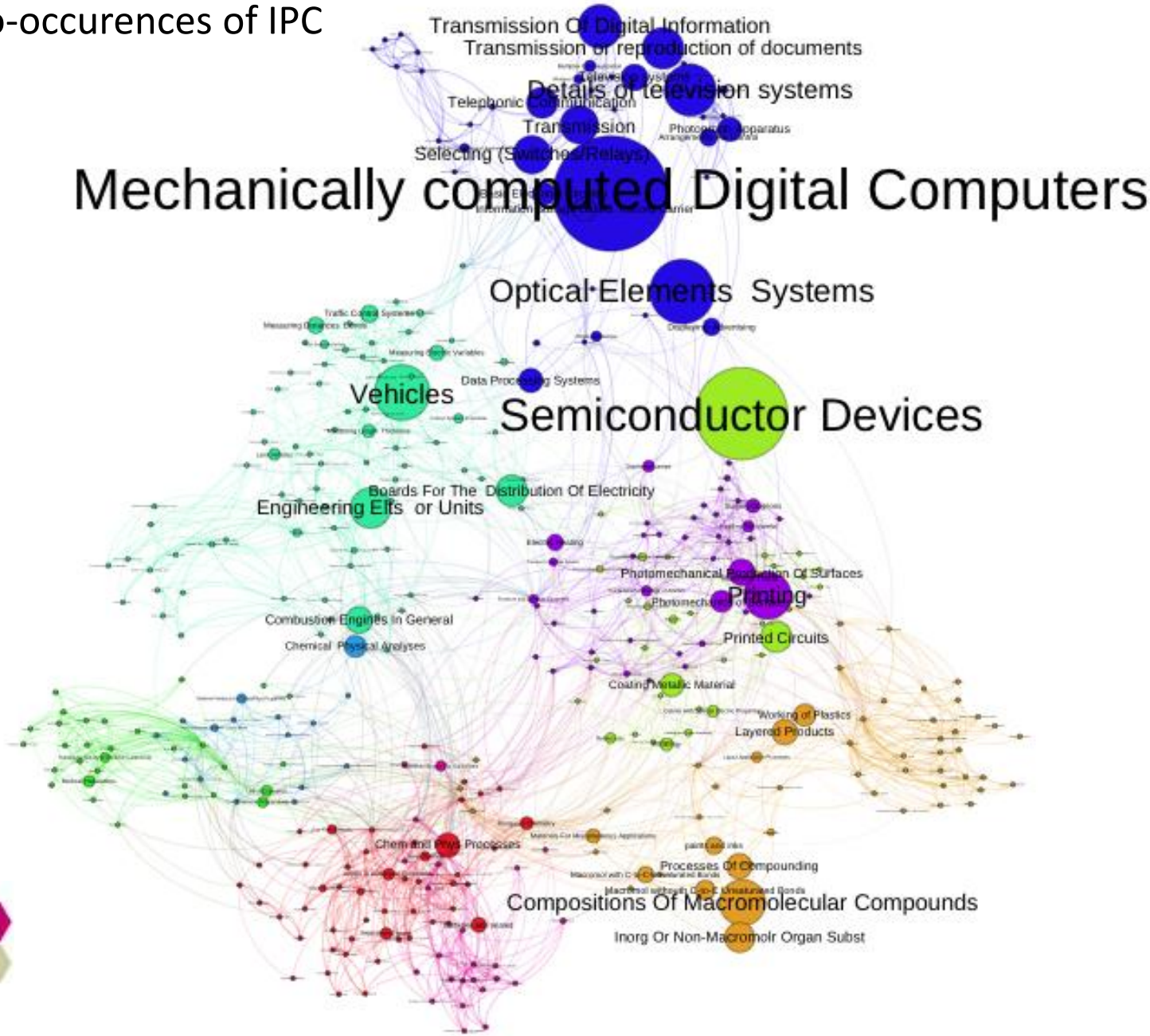
The entropy value of the distribution of patents can be calculated from the distribution of occurrences in the three-dimensional space Hxyz. These values will inform us about the extent to which the distributions among the three dimensions are related to one another.

Further Research 4/4

Updating the CIB database with 3 more years of patents – but unchanged corporates perimeters. Time lag issue between R&D investments and patent applications – and publications

Assessing and improving the CIB data quality through a benchmark with existing harmonisations (OECD and KUL) and a meta-harmonisation process.

Thanks for your attention and comments

Global Map of Technology

Based on co-occurences of IPC codes