The First Globelics Conference on Innovation Systems and Development Strategies

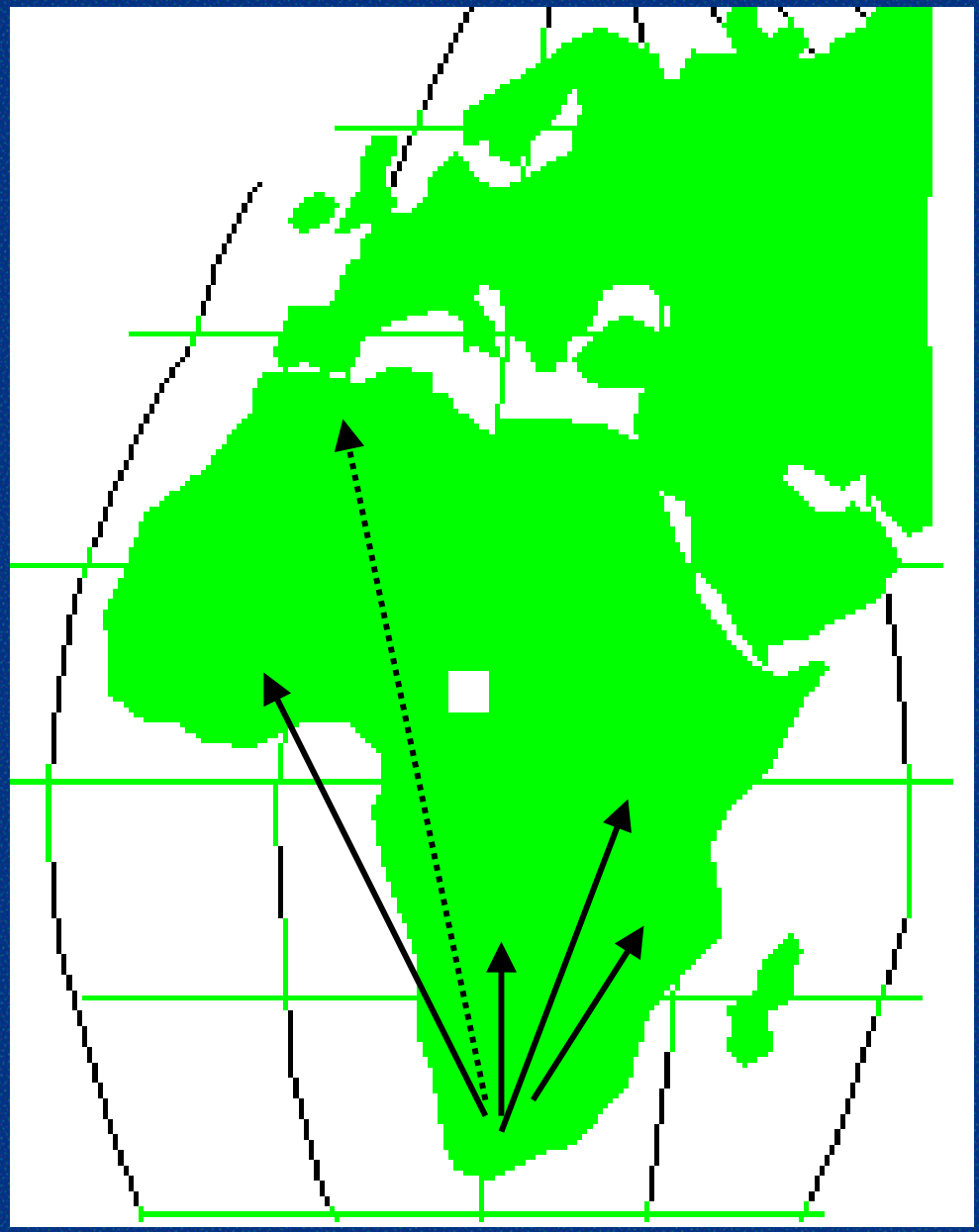
Return on Investment in Innovation: Implications for Institutions and National Agencies

Tony Heher, Director, UCT Innovation
University of Cape Town, South Africa
Tony.Heher@UCT-Innovation.co.za
and
Past President of SARIMA

SARIMA

Southern African Research & Innovation Management Association

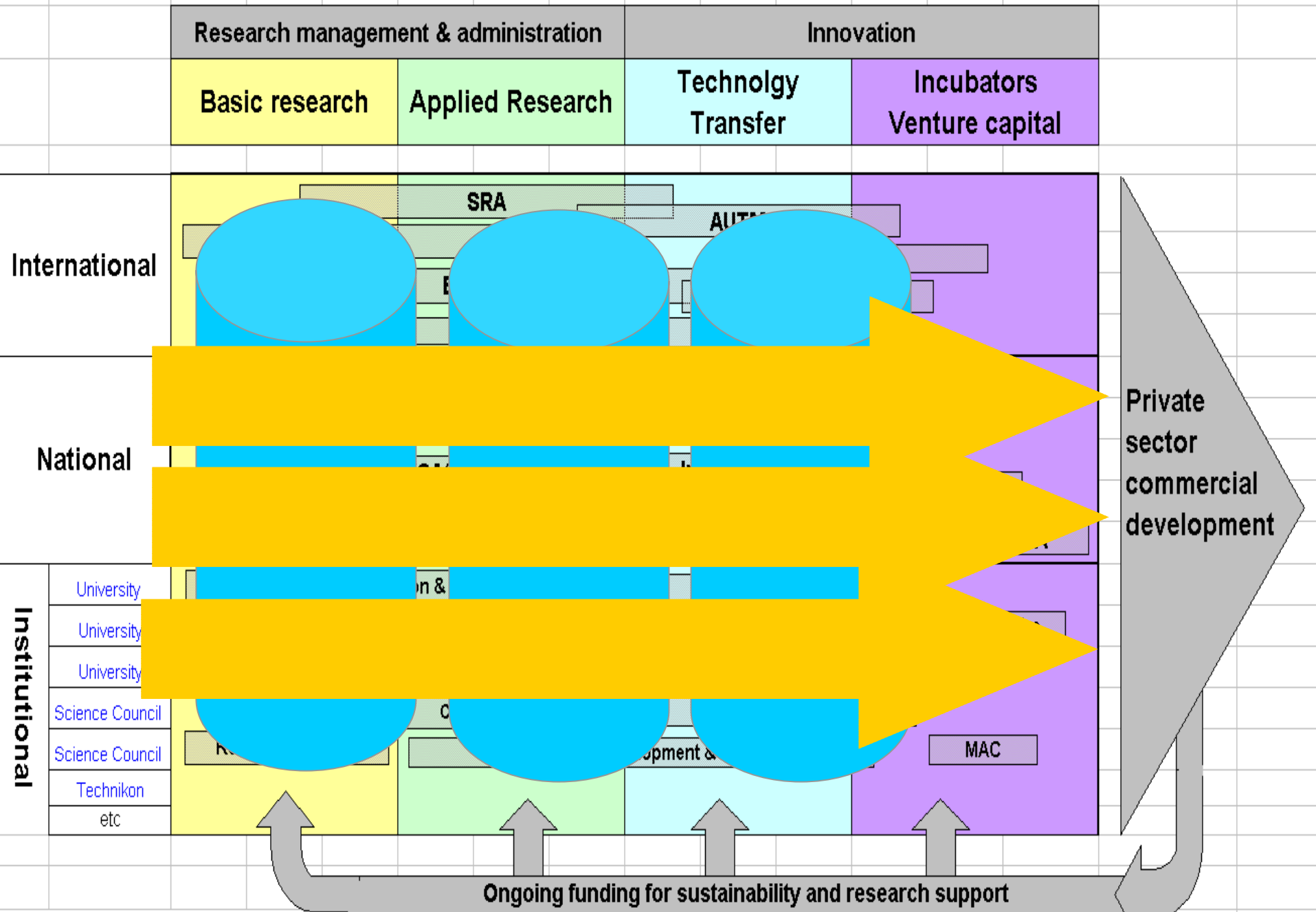
- **Advancement of research and innovation for economic and social benefit**
- **Professional development and capacity building**
- **Best practice in research and innovation**
- **Policy advocacy**



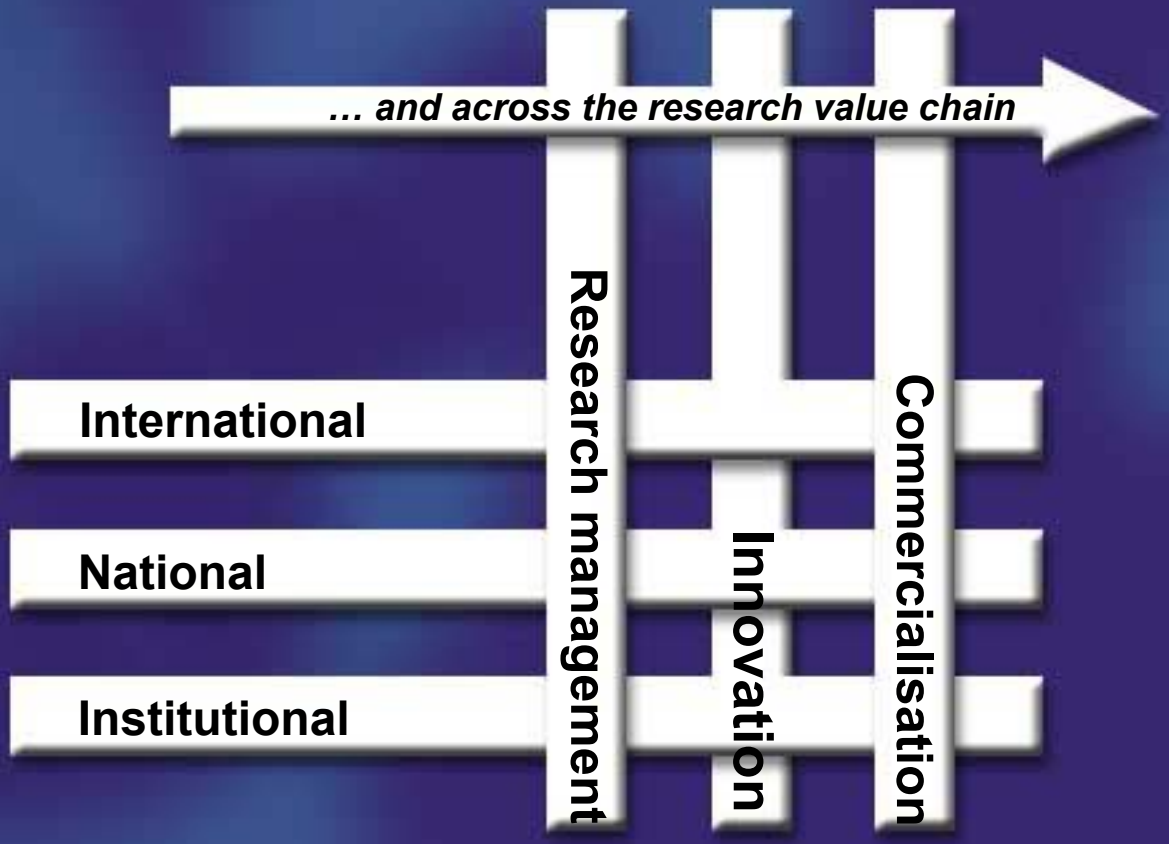
Based in South Africa but building links into Africa

SETT project (Sharing of Expertise in Technology Transfer)

Examples of the spectrum of institutions involved in the research and innovation value chain



SARIMA operates at …



… to weave research into the fabric of society

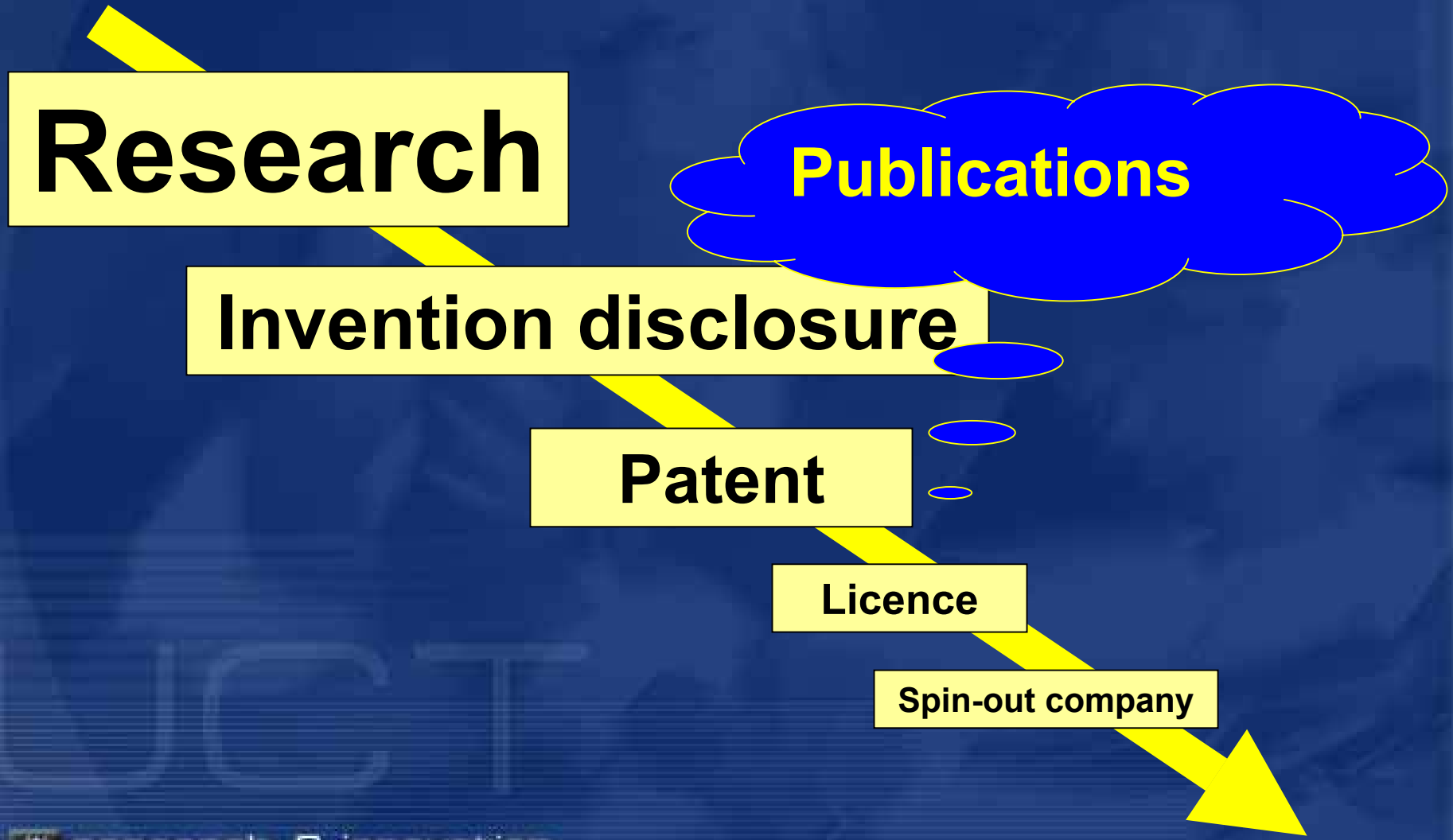
Objectives of paper:

- Present some “work in progress”
- Find out who is interested
- Pose some questions
- Suggest some answers
- Look for partners to take this forward

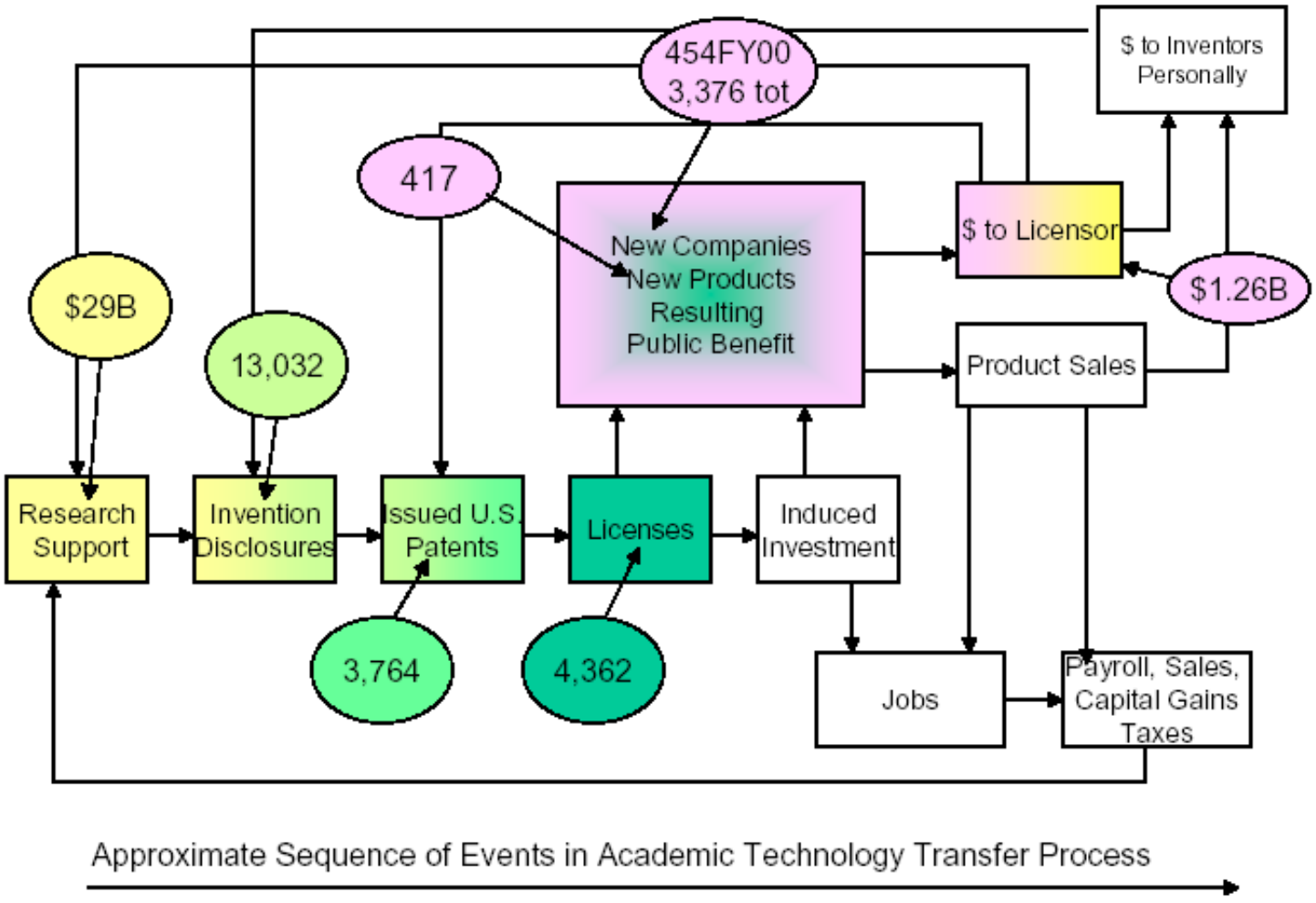
Subtitle: The Humble Innovation Practitioner

(with thanks to Tony Hoare of Oxford who wrote about and taught me to be a “humble programmer”)

Research & Innovation Value chain:

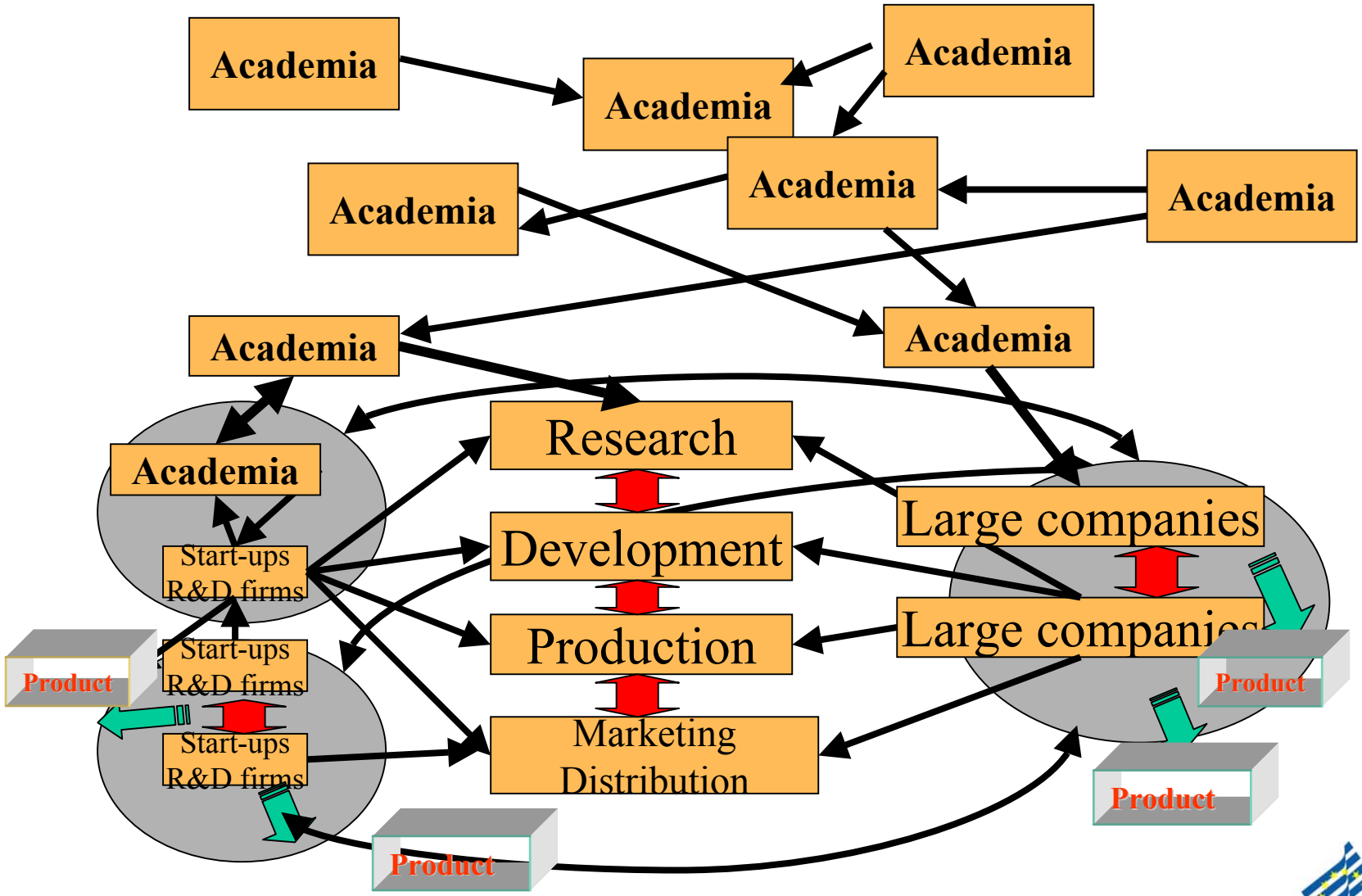


What can you count inside the University? (#'s FY00 AUTM Survey)



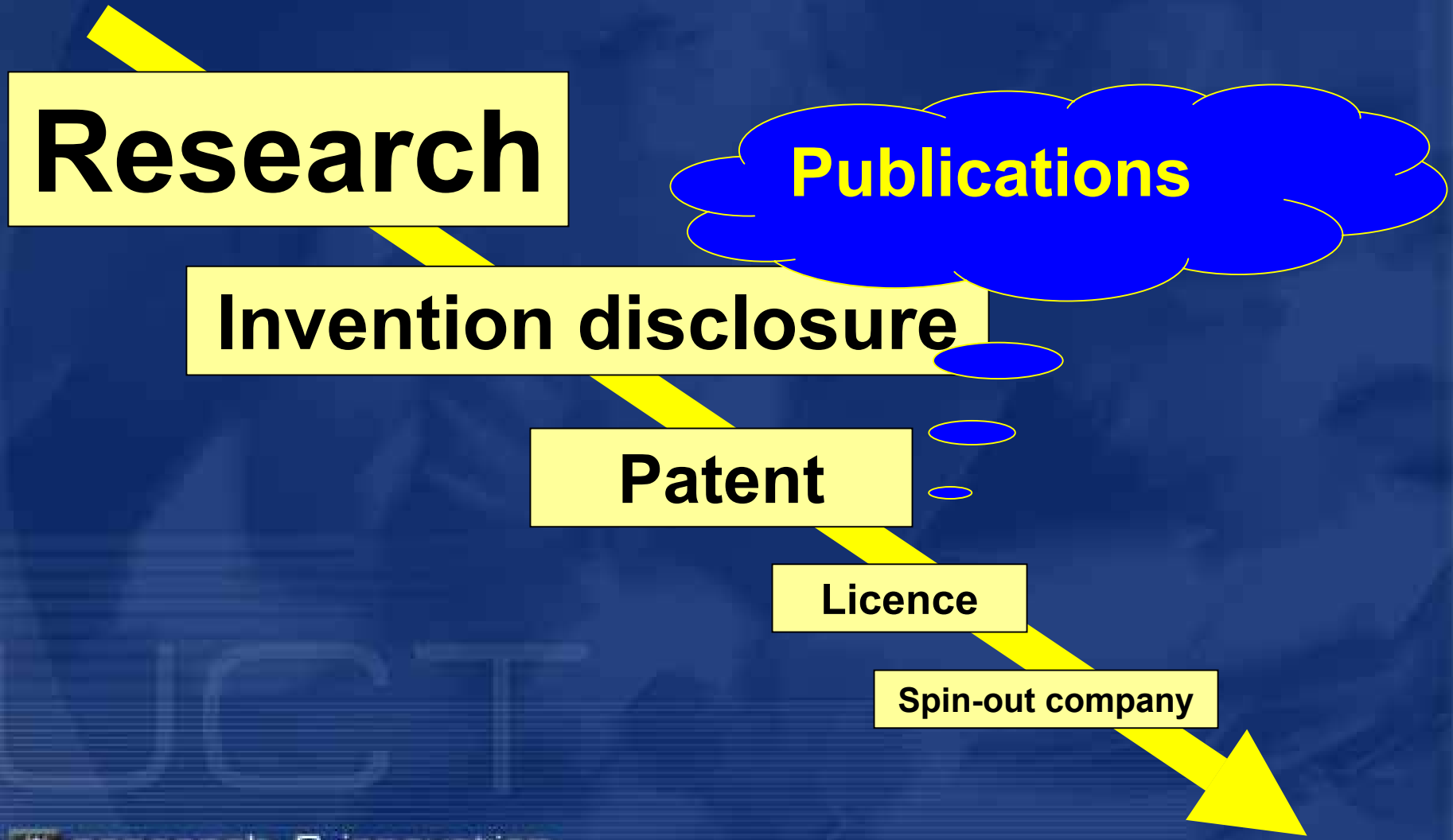
From: Lori Pressman, What is Known and Knowable about the Economic Impact of University Technology Transfer, AUTM 2000

A complex web of academic research over decades:



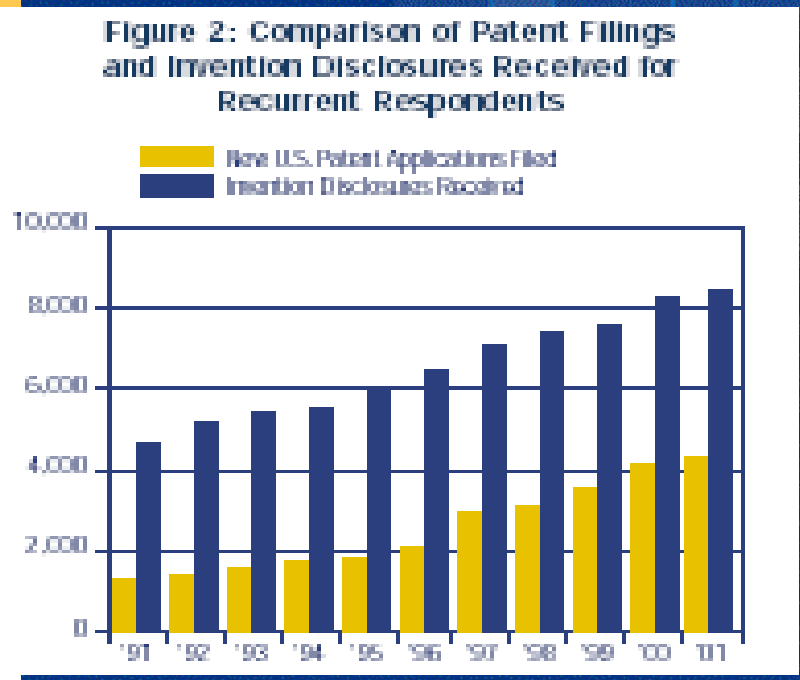
EARMA
THE EUROPEAN ASSOCIATION OF RESEARCH MANAGERS AND ADMINISTRATORS

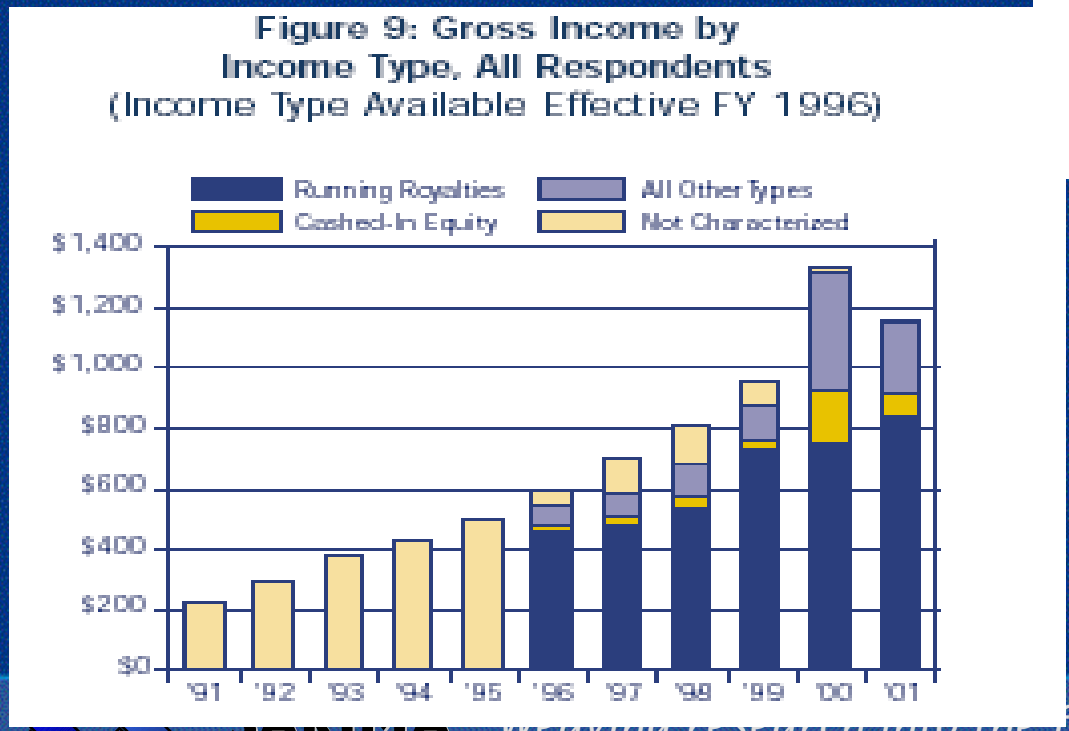
Research & Innovation Value chain:

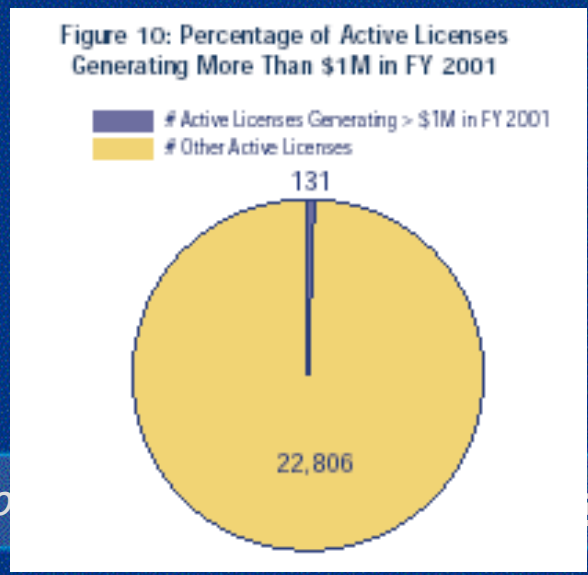


AUTM Licensing Survey: FY 2001

Survey Summary







AUTM Survey Data Fields[+], totals, some averages and ratios

Field description	Totals	Averages and ratios	
(all data for FY 2000 except where agregated)		(all $ in $ millions)	
Name of the Institution	190	Number in survey	
Year which Institution started	1987	13	Average office age
Licensing FTEs Technology Transfer Office	634	3.3	Professional staff
Other FTEs Technology Transfer Office	669	3.5	Support staff
Research Expenditures: Industrial Sources	$2,729	9.3%	% industrial
Research Expenditures: Federal Govt. Sources	$18,076	61.3%	% federal
Total Research Expenditures	$29,492		
Licenses/Options Executed	4,362	$6.76	$m research/licence
		33%	of disclosures
Licenses Executed with Equity	372	9%	of total
Cumulative Active Licenses though FY 2000	20,968	21%	in current year
Licenses Executed on Exclusive Basis*	2,161	50%	of total
Licenses Executed on Non-Exclusive Basis*	2,136	49%	of total
Licenses Executed to Start-Up Companies*	626	14%	of total
Licenses Executed to Small Companies (Excl. Start-ups)*	2,009	46%	of total
Licenses Executed to Large Companies*	1,359	31%	of total
Licenses/Options to Start-Up Companies: Exclusive*	558	89%	of start-ups
Licenses/Options to Start-Up Companies: Non-Exclusive*	60	10%	of start-ups
Licenses/Options to Small Companies: Exclusive*	846		
Licenses/Options to Small Companies: Non-Exclusive*	1,156		
Licenses/Options to Large Companies: Exclusive*	497		
Licenses/Options to Large Companies: Non-Exclusive*	849		
Research Funding Related to Licenses/Options	$236		
License Income Received	$1,335	4.5%	of total expend
Licenses/Options Generating License Income	9,059	$0.15	Av income
		43%	Licences active
License Income Rec'd Paid to Other Institutions	$72		
License Income Rec'd : Running Royalties*	$751		
Licenses/Options Generating Running Royalties	4,581		
License Income Rec'd : Other Income*	$391		
Licenses/Options Generating More Than $1M	125	0.6%	
Legal Fees Expended	$141	11%	of licence income
Legal Fees Reimbursed	$63	5%	of licence income
Invention Disclosures Received	13,032	$2.3	$m per disclosure
Total Patent Applications Filed	9,925	76%	of disclosures
New Patent Applications Filed	6,375	49%	of disclosures
U.S. Patents Issued (per Survey)	3,764	29%	of disclosures
Start-ups Initiated	454	$65.0	$m per startup
		3.5%	of disclosures
Start-ups Initiated Operating Home State	364	80%	
Start-ups That Became Non-Operational	59	3%	
Cumulative Operational Start-ups as of the end of 2000	2,309		
Start-ups Formed which the Institution Holds Equity	252	56%	

Country benchmark data

Abstracted data for a few countries with SA projections									
		Disclosures		Licences/Patents			Spin-outs		Licence + Spin-out
	$Research	No	$Research /disclosure	#Licences/ disclosures	$Research /Licence	Income as % research	#Spin-outs/ disclosure	$Research /spin-out	
USA[1]	$29b	13,032	$2.3m	33%	$6m	4.5%	3.5%	$66m	37%
UK[2]	$2.6b	1,402	$1.8m	20%	$9m	1%	12%	$14m	32%
Canada[1]	$1.4b	875	$1.6m	15%	$10m	2%		$38m	
Australia[3]	$510m	274	$1.9m	23%	$8m		4%	$31m	27%
Scotland[4]	$347m	216	$1.6m	17%	$8m		5%	$17.6	
Europe[5]	$3.5b	1,522	$2.3m	16%	$14m	1.4%	17%	$13.2	33%
USA mid-50[6]	$4.5b	2,073	$2.2m	33%	$6m	1.7%	4%		37%

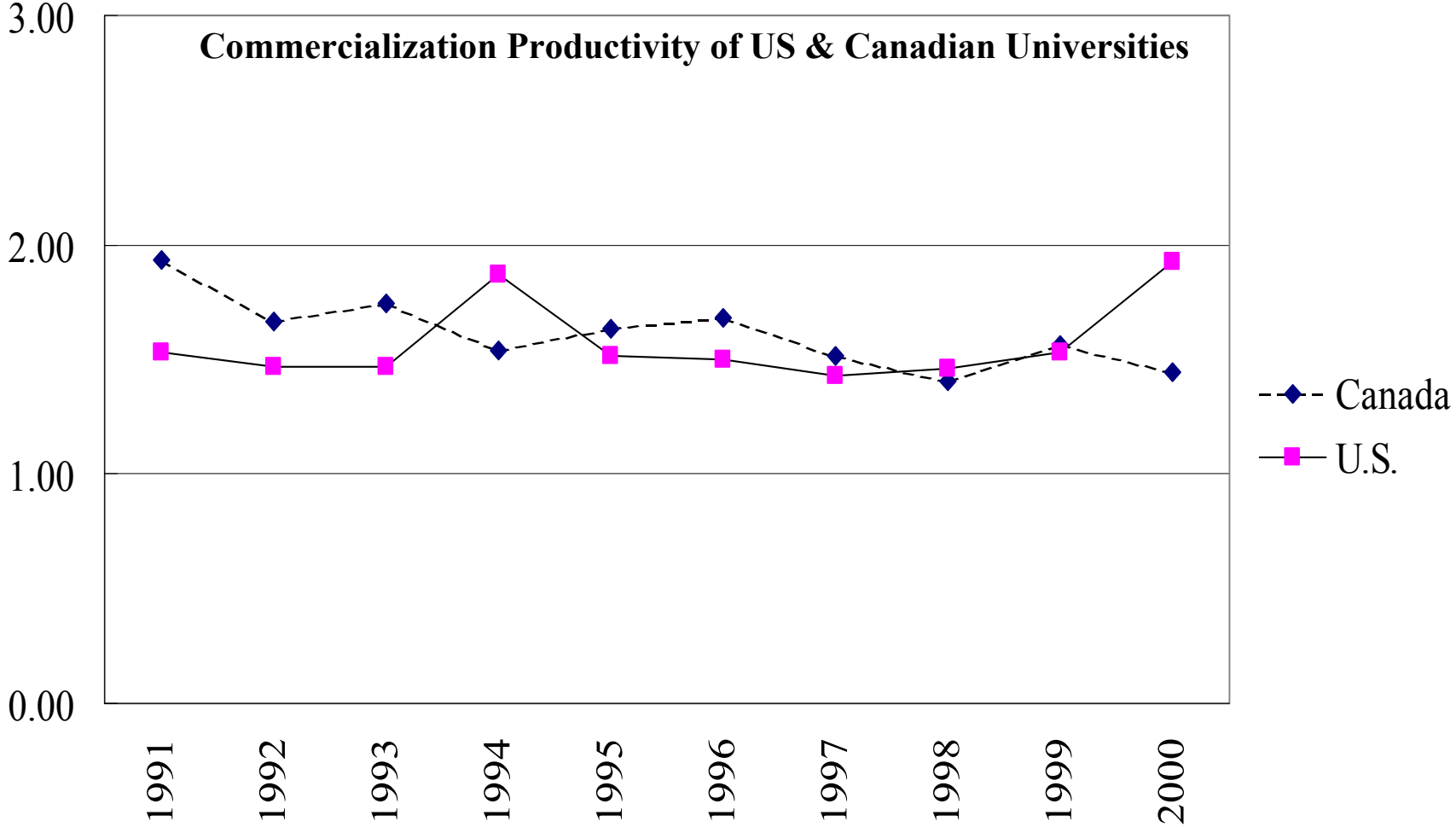
(ppp adjusted)

1. Association of Unversity Technoloy Managers (AUTM) FY 2000 survey
2. UNICO-NUBS Survey on University Commercialisation 2001
3. Australasian Tertiary Institutions Commercial Companies Association Inc (ATICCA) 1988
4. Edinburgh University Research and Innovation Office (for 1999/2000)
5. The Association of European Science and Technology Transfer Professionals (ASTP) Feb 2001
6. AUTM survey mid-50% ($15m to $100m research expenditure universties & ignoring outliers)

Invention disclosure, the trigger point

		Disclosures		Licences/Patents			Spin-outs	
	$Research (2000)	No	$Research /disclosure	#Licences/ disclosures	$Research /Licence	Income as % research	#Spin-outs/ disclosure	$Research /spin-out
USA			$2.6m					
UK			$1.8m					
Canada			$1.6m					
Australia			$1.9m					
Scotland			$1.6m					
Europe			€2.3m					

$M Research Expenditure per Invention Disclosure
(after Correction for Indirect Costs)



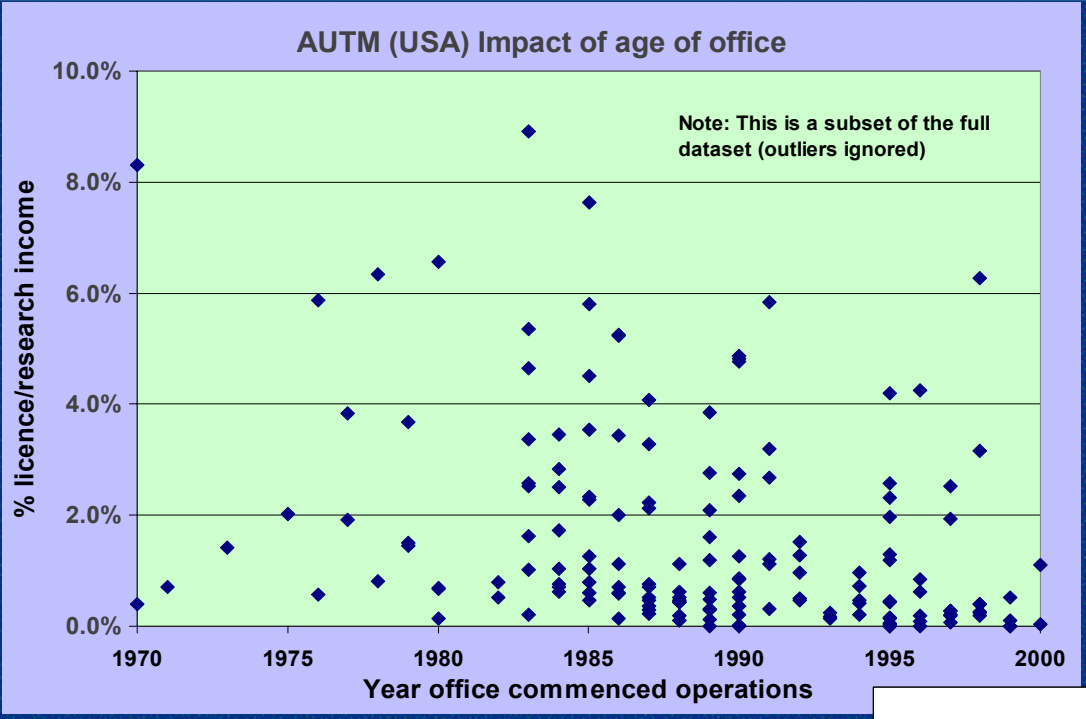
Question #1

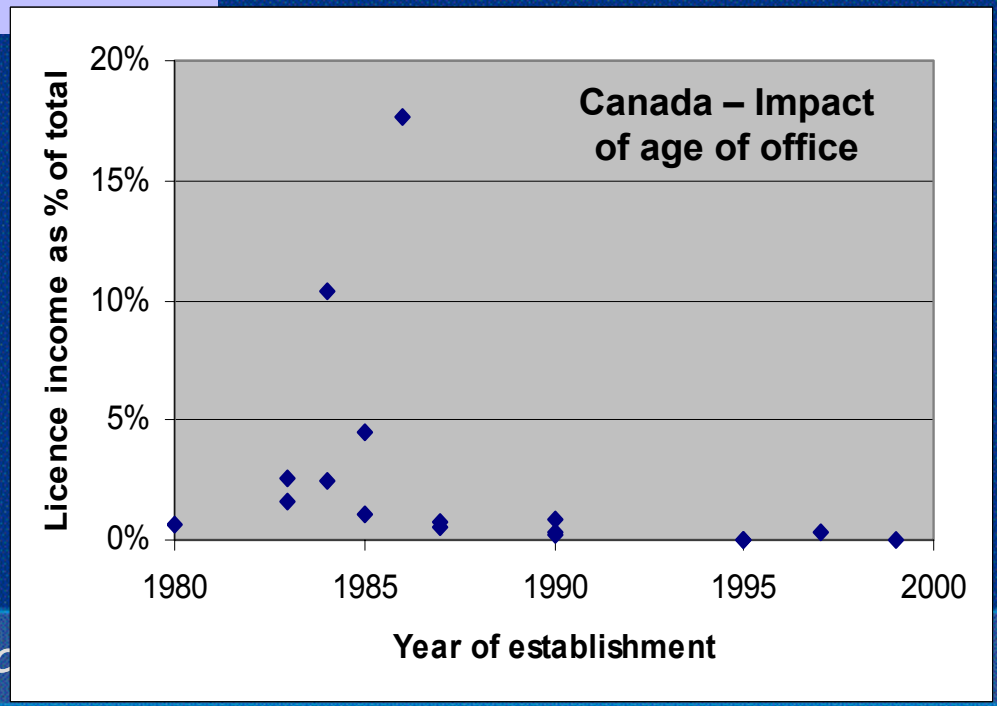
$m of research per disclosure "constant"

- What is this "constant"?
- Is it fundamental or accidental?
- Can we change it?
- Are we measuring it correctly?

What are the causes of variations?

		Disclosures		Licences/Patents			Spin-outs	
	$Research (2000)	No	$Research /disclosure	#Licences/ disclosures	$Research /Licence	Income as % research	#Spin-outs/ disclosure	$Research /spin-out
USA						4%		
UK						1%		
Canada						2%		
Australia								
Scotland								
Europe						1.4%		

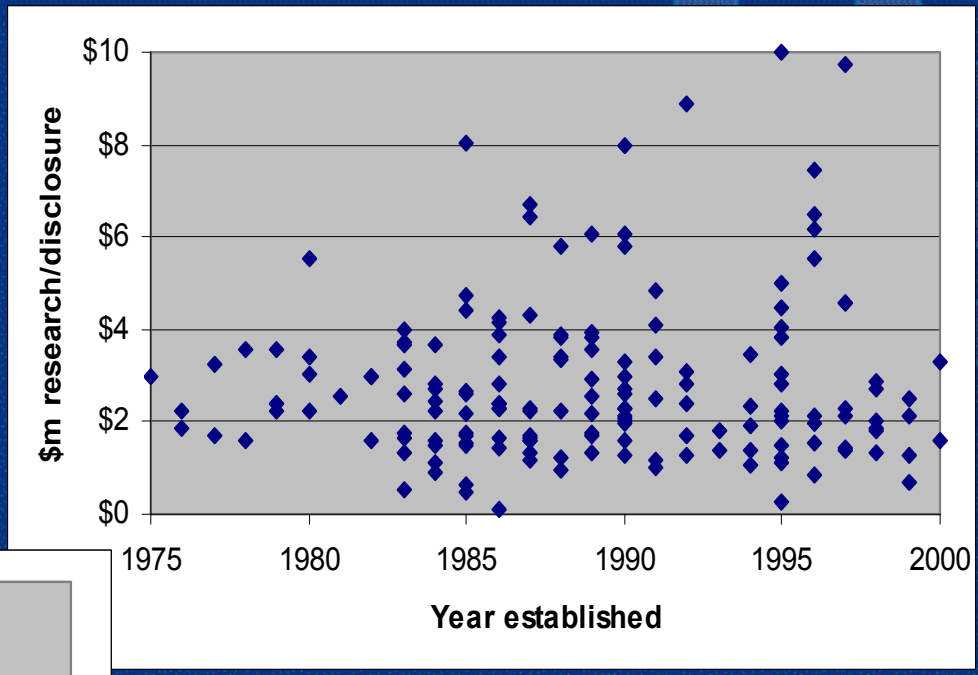


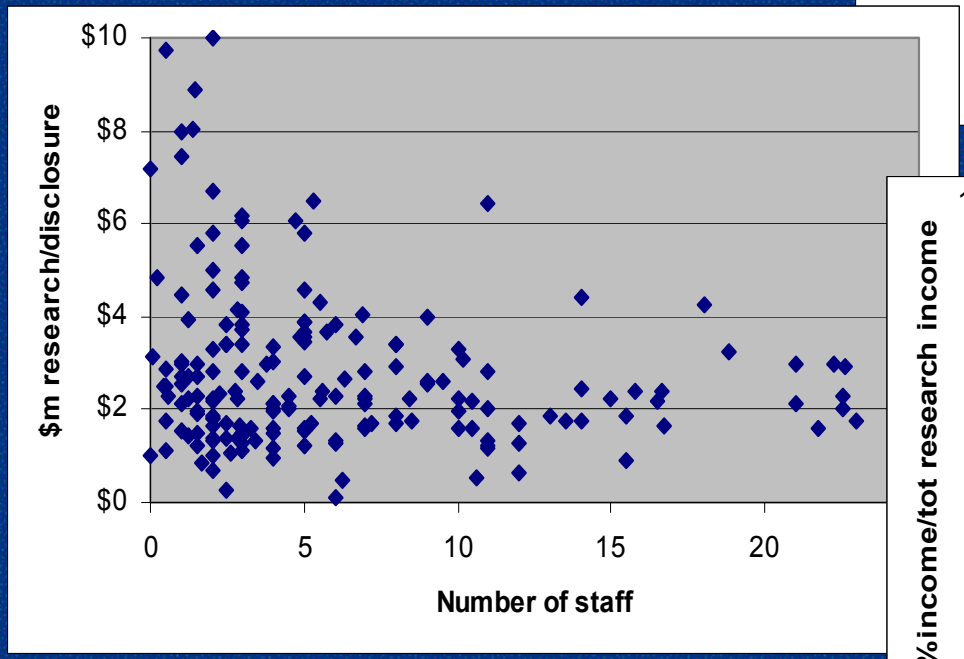


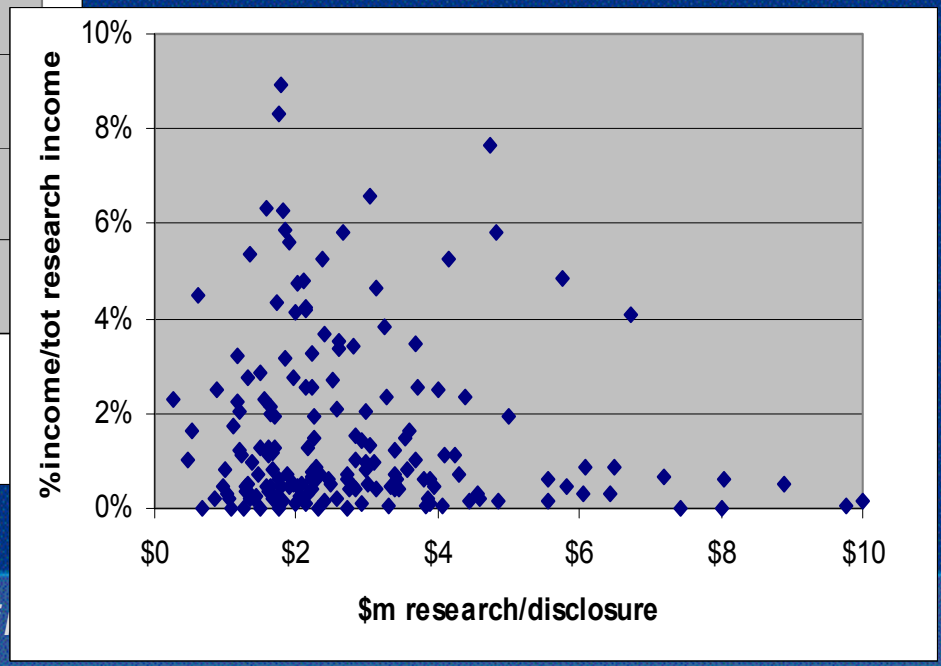
SARIMA *Weaving researc*

Disclosure rate a constant??

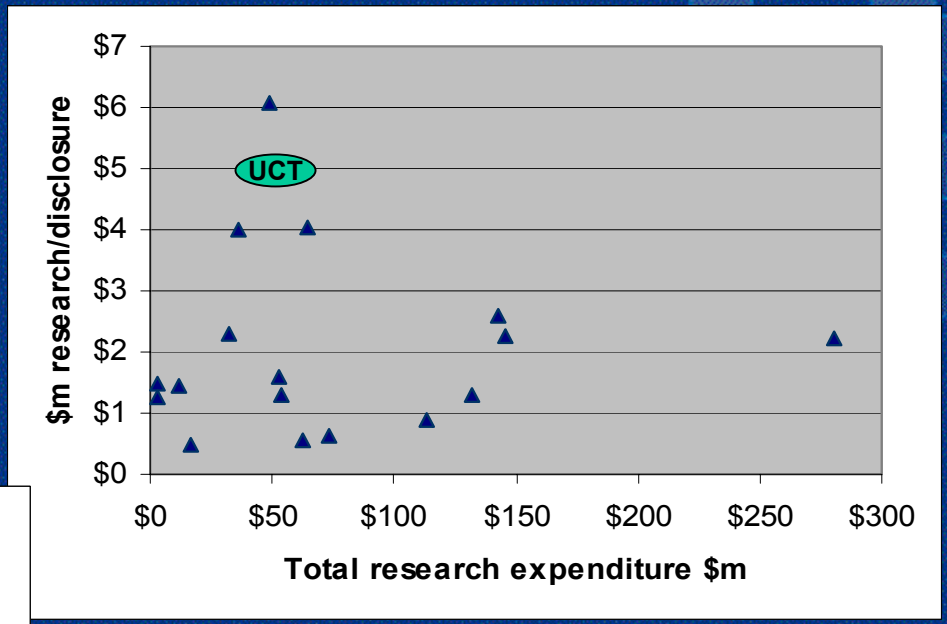
(you must be joking)

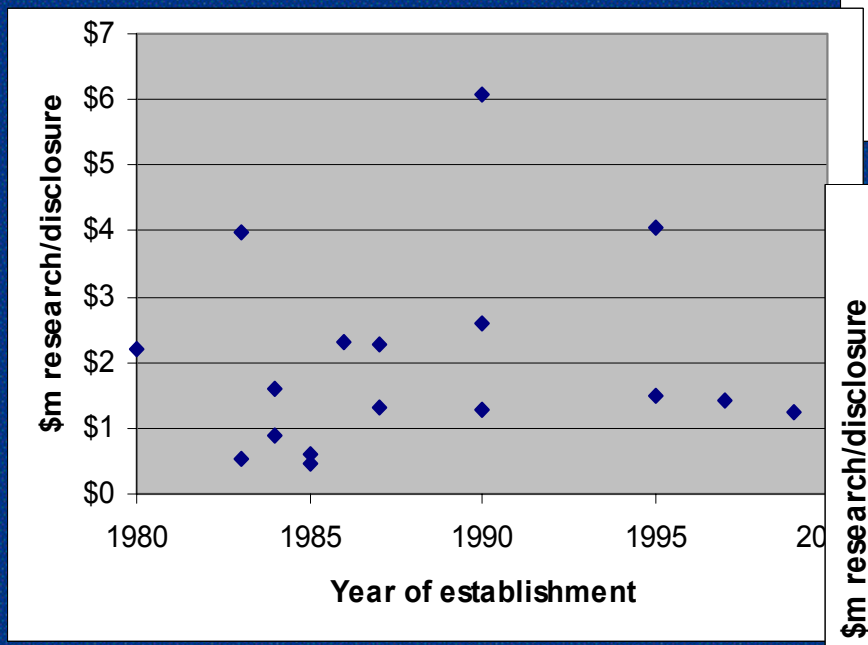


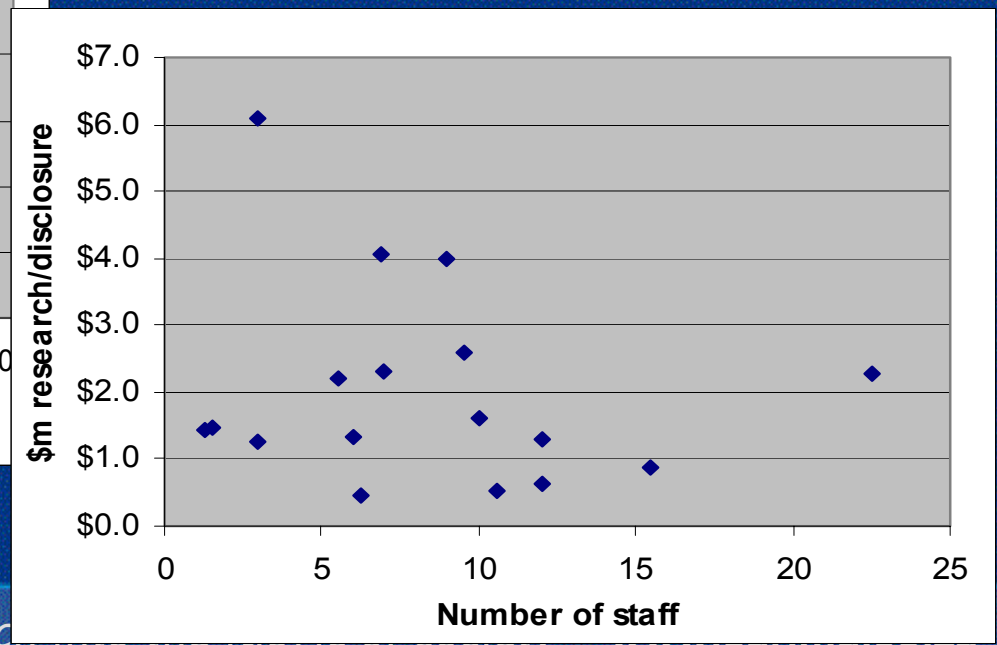




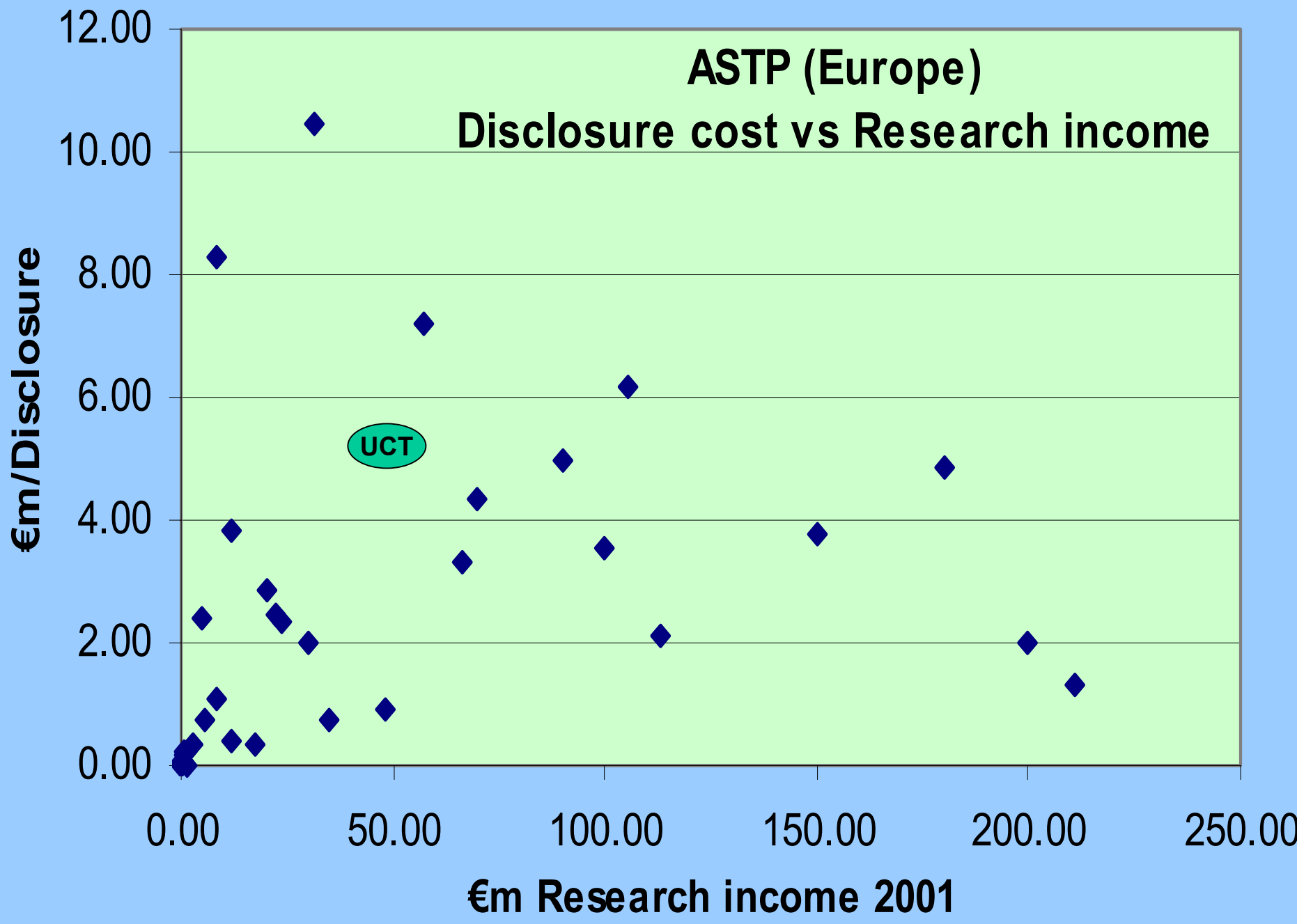
Canada – correlation of various parameters







(from Commercialization Productivity of Canadian Universities)


ASTP (Europe)
Disclosure cost vs Research income
€m/Disclosure
12.00
10.00
8.00
6.00
4.00
2.00
0.00
UCT
0.00
50.00
100.00
150.00
200.00
250.00
€m Research income 2001

Conclusions

- The amount of technology that is measurably transferred from universities appears to be roughly a linear function of Research Expenditures in both the U.S. and Canada, with roughly the same constants of proportionality
- There is no evidence to support the idea that who owns the intellectual property results in more or better technology transfer - institutional commitment to technology transfer is much more important
- Some universities have higher commercialization productivity in most or all of the measures…
- Long-standing institutional commitment to knowledge transfer…key factor

Question #2

Variability in performance

- Why?
- If it is “institutional commitment”, what does that mean?
- Can we change it?
- Are we measuring it correctly?

Use & abuse of benchmark data

Abstracted data for a few countries with SA projections									
		Disclosures		Licences/Patents			Spin-outs		Licence + Spin-out
	$Research	No	$Research /disclosure	#Licences/ disclosures	$Research /Licence	Income as % research	#Spin-outs/ disclosure	$Research /spin-out	
USA[1]	$29b	13,032	$2.3m	33%	$6m	4.5%	3.5%	$66m	37%
UK[2]	$2.6b	1,402	$1.8m	20%	$9m	1%	12%	$14m	32%
Canada[1]	$1.4b	875	$1.6m	15%	$10m	2%		$38m	
Australia[3]	$510m	274	$1.9m	23%	$8m		4%	$31m	27%
Scotland[4]	$347m	216	$1.6m	17%	$8m		5%	$17.6	
Europe[5]	$3.5b	1,522	$2.3m	16%	$14m	1.4%	17%	$13.2	33%
USA mid-50[6]	$4.5b	2,073	$2.2m	33%	$6m	1.7%	4%		37%

(ppp adjusted)

1. Association of Unversity Technoloy Managers (AUTM) FY 2000 survey
2. UNICO-NUBS Survey on University Commercialisation 2001
3. Australasian Tertiary Institutions Commercial Companies Association Inc (ATICCA) 1988
4. Edinburgh University Research and Innovation Office (for 1999/2000)
5. The Association of European Science and Technology Transfer Professionals (ASTP) Feb 2001
6. AUTM survey mid-50% ($15m to $100m research expenditure universties & ignoring outliers)

Question #3

Use and abuse of benchmarks

- **Is the "average" performance as constant as it seems?**
- **What are the implications of this?**
- **Why is this data so sadly and badly abused?** (*by those who ought to know better)*

Benchmark best practice

- Start measuring regularly… even if simple & a few fields in the beginning
- Follow international standards to permit cross country comparison
- Benchmarks are always a proxy. Interpret with understanding and caution - do not misuse, overuse or abuse

Best practice benchmarking is learning-by-comparing, not a bludgeon! … and be humble

Predicting performance from benchmark data

Abstracted data for a few countries with SA projections

		Disclosures		Licences/Patents			Spin-outs		Licence + Spin-out
	$Research	No	$Research /disclosure	#Licences/ disclosures	$Research /Licence	Income as % research	#Spin-outs/ disclosure	$Research /spin-out	
USA[1]	$29b	13,032	$2.3m	33%	$6m	4.5%	3.5%	$66m	37%
UK[2]	$2.6b	1,402	$1.8m	20%	$9m	1%	12%	$14m	32%
Canada[1]	$1.4b	875	$1.6m	15%	$10m	2%		$38m	
Australia[3]	$510m	274	$1.9m	23%	$8m		4%	$31m	27%
Scotland[4]	$347m	216	$1.6m	17%	$8m		5%	$17.6	
Europe[5]	$3.5b	1,522	$2.3m	16%	$14m	1.4%	17%	$13.2	33%
USA mid-50[6]	$4.5b	2,073	$2.2m	33%	$6m	1.7%	4%		37%

Projections to SA if operating at international norms (high/low ratios used)

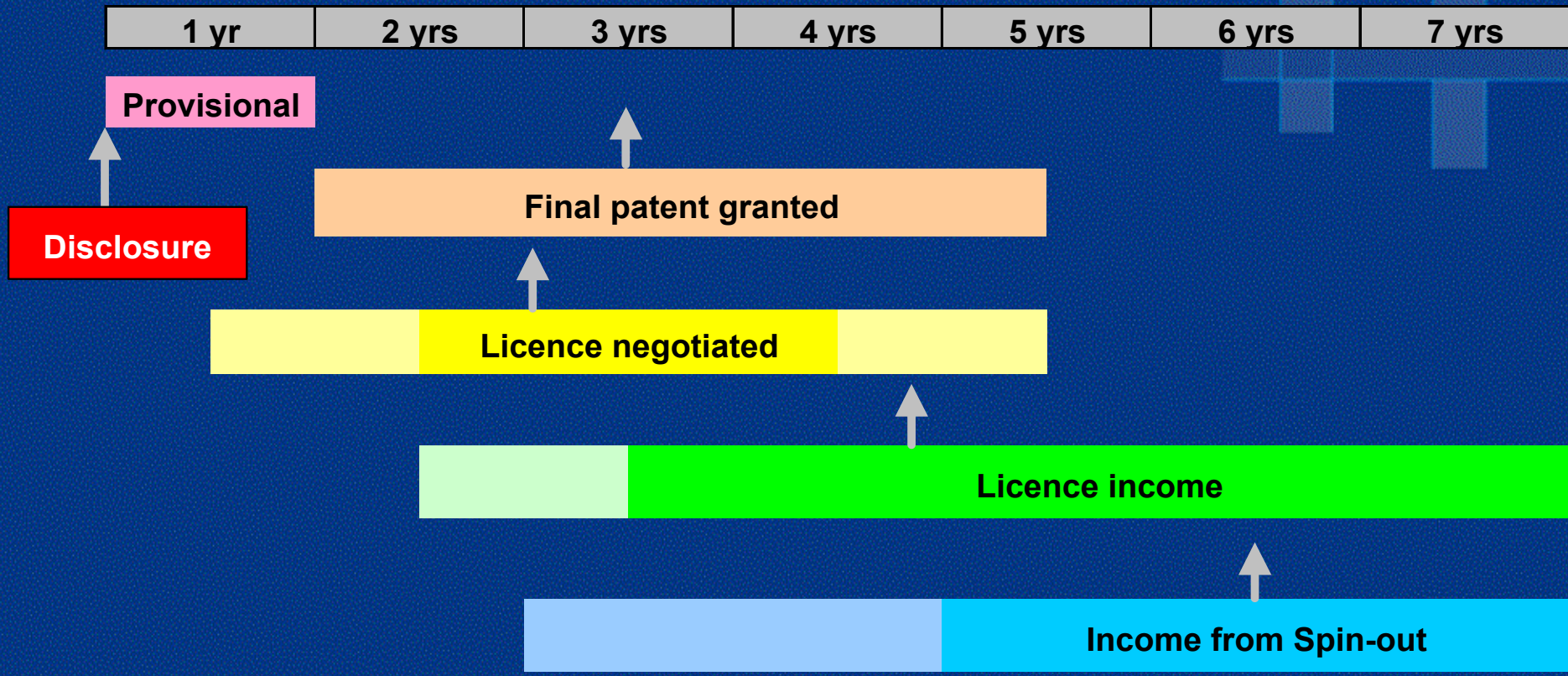
		# disclosures	# patents/licences	Income	# Spin-outs
S Africa	$500m (ppp adjusted)	250 - 300	50 - 80	$3-$10m	10 - 50

1. Association of Unversity Technoloy Managers (AUTM) FY 2000 survey
2. UNICO-NUBS Survey on University Commercialisation 2001
3. Australasian Tertiary Institutions Commercial Companies Association Inc (ATICCA) 1988
4. Edinburgh University Research and Innovation Office (for 1999/2000)
5. The Association of European Science and Technology Transfer Professionals (ASTP) Feb 2001
6. AUTM survey mid-50% ($15m to $100m research expenditure universties & ignoring outliers)

… and that was the easy bit

(*a snapshot in time of a psuedo steady state system)*

The phasing of the value chain



Difficult to generalize. Averages hide wide variation in individual transactions

Technology Transfer Model - Institutional and national effects

	Parameter	Years lag	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Research Rm			100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Disclosures	R 8.0		13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Patents	50%	1		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Average patent cost Rm	R 0.2	0		R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3
Licences	20%	2			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Licences lapsing		7										3	3	3	3	3	3	3	3	3	3	3
Licences cumulative	#	0	1	1	4	6	9	11	14	16	19	19	19	19	19	19	19	19	19	19	19	19
Royalties Rm	R 0.2	3				R 0.2	R 0.2	R 0.7	R 1.2	R 1.7	R 2.2	R 2.7	R 3.2	R 3.7	R 3.7	R 3.7	R 3.7	R 3.7	R 3.7	R 3.7	R 3.7	R 3.7
Spin-outs	10%	4					1.3	1.3	1.3	1.3	1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3
Income from sale of spinout Rm	R 3.0	5										R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8
Total income	Rm					R 0.2	R 0.2	R 0.7	R 1.2	R 1.7	R 2.2	R 6.5	R 7.0	R 7.5	R 7.5	R 7.5	R 7.5	R 7.5	R 7.5	R 7.5	R 7.5	R 7.5
Office costs (salaries & overhead	R 0.3	15%	R 0.3	R 0.3	R 0.3	R 0.3	R 0.3	R 0.4	R 0.5	R 0.6	R 0.6	R 1.3	R 1.3	R 1.4	R 1.4	R 1.4	R 1.4	R 1.4	R 1.4	R 1.4	R 1.4	R 1.4
IP costs	Rm			R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3
Net income	Rm		0	-R 1.6	-R 1.6	-R 1.4	-R 1.4	-R 1.0	-R 0.5	-R 0.1	R 0.3	R 3.9	R 4.4	R 4.8	R 4.8	R 4.8	R 4.8	R 4.8	R 4.8	R 4.8	R 4.8	R 4.8
Cumulative income			0	-R 1.6	-R 3.1	-R 4.5	-R 5.9	-R 6.8	-R 7.3	-R 7.5	-R 7.1	-R 3.2	R 1.2	R 5.9	R 10.7	R 15.5	R 20.3	R 25.1	R 29.9	R 34.6	R 39.4	R 44.2
IRR to institution							0%	0%	0%	0%	0%	-9%	2%	9%	13%	15%	17%	18%	19%	20%	20%	21%
Income as % Research					-1.6%	-1.4%	-1.4%	-1.0%	-0.5%	-0.1%	0.3%	3.9%	4.4%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%

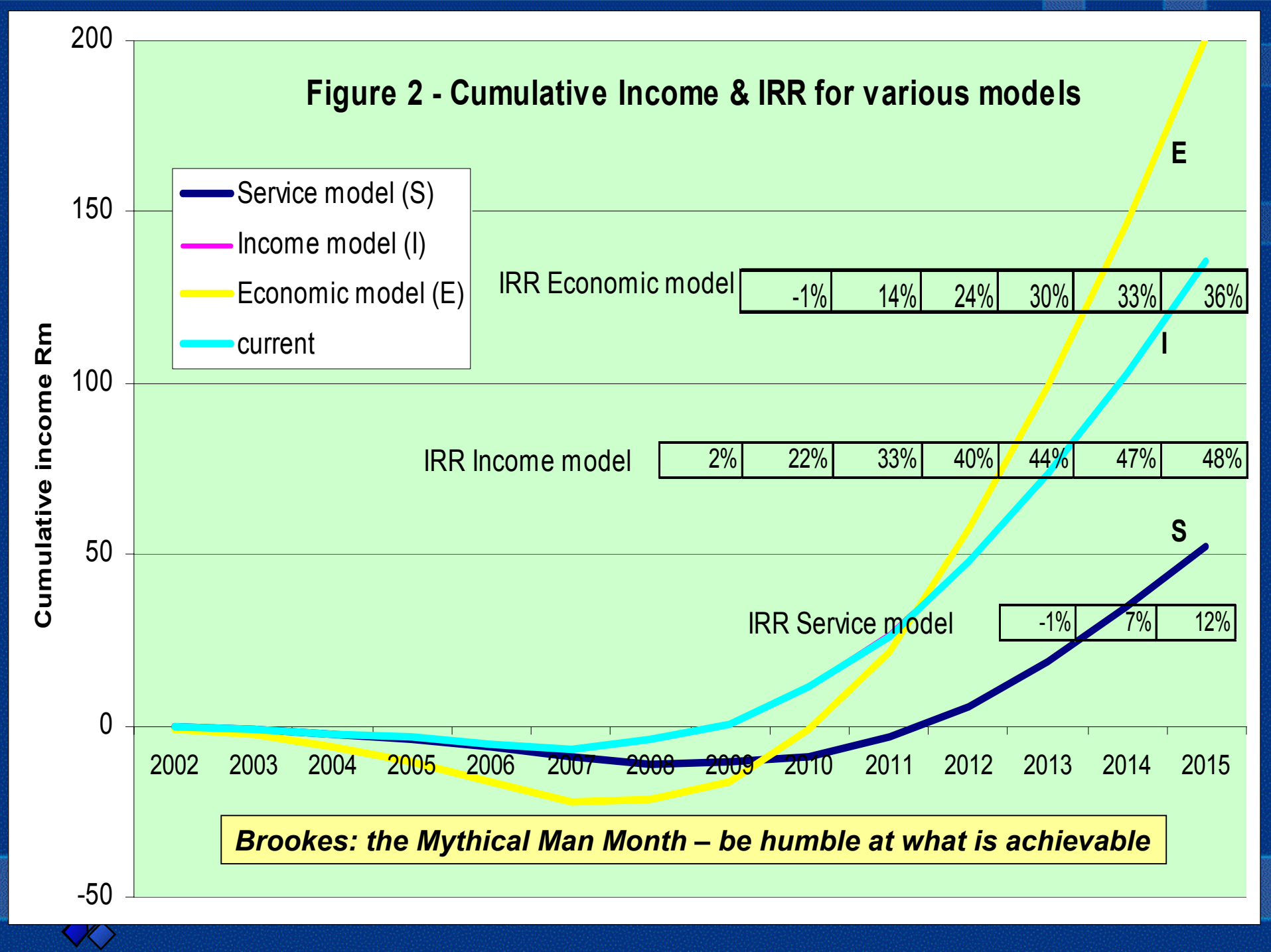


Figure 2 - Cumulative Income & IRR for various models
Cumulative income Rm
200
150
100
50
0
-50
Service model (S)
Income model (I)
Economic model (E)
current
IRR Economic model
-1%
14%
24%
30%
33%
36%
IRR Income model
2%
22%
33%
40%
44%
47%
48%
IRR Service model
-1%
7%
12%
E
I
S
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Brookes: the Mythical Man Month – be humble at what is achievable

Question #4

Dynamic model

- Is this a useful representation?
- How do we make this more accurate?
- Can we calibrate using past performance?
- Is this extensible to new institutions and countries?

Question #4.1 – some answers

Is this a useful representation?

- Absolutely yes!
- Institutions operate on 3-5 year medium term budget framework
- Invaluable for dashing unrealistic expectations
- But dangerous as a predictive tool

Question #4.4 – some answers

Is this extensible to new institutions and countries?

- **Yes, because the model is general** *(parameters are specific)*
- **Can be used with imperfect data (***with caution and understanding of underlying system – be humble about what you know)*

Estimating economic impact

Guesstimates from FY00 AUTM Data

If 2% average royalty rate:
Preproduction, about $5B
Product Sales, about $35B
Jobs Supported, about 250,000
Taxes: about $5B

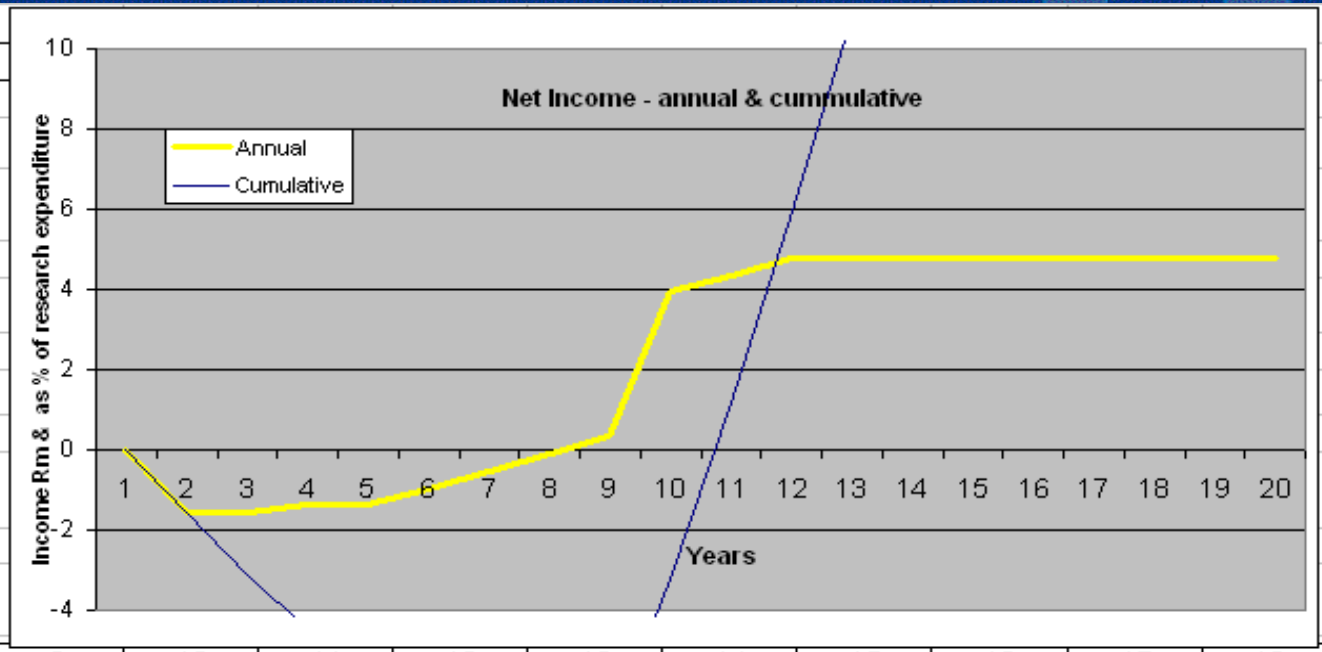
If 4% average royalty rate:
Preproduction, about $5B
Product Sales, about $17.5B
Jobs Supported, about 140,000
Taxes: about $3B

From: Lori Pressman, What is Known and Knowable about the Economic Impact of University Technology Transfer, AUTM 2000

Technology Transfer Model - Institutional and national effects

	Parameter	Years lag	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Research Rm			100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Disclosures	R 8.0		13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Patents	50%	1		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Average patent cost Rm	R 0.2	0		R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3
Licences	20%	2			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Licences lapsing		7										3	3	3	3	3	3	3	3	3	3	3
Licences cumulative	#	0	1	1	4	6	9	11	14	16	19	19	19	19	19	19	19	19	19	19	19	19
Royalties Rm	R 0.2	3				R 0.2	R 0.2	R 0.7	R 1.2	R 1.7	R 2.2	R 2.7	R 3.2	R 3.7	R 3.7	R 3.7	R 3.7	R 3.7	R 3.7	R 3.7	R 3.7	R 3.7
Spin-outs	10%	4					1.3	1.3	1.3	1.3	1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3
Income from sale of spinout Rm	R 3.0	5										R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8	R 3.8
Total income	Rm					R 0.2	R 0.2	R 0.7	R 1.2	R 1.7	R 2.2	R 6.5	R 7.0	R 7.5	R 7.5	R 7.5	R 7.5	R 7.5	R 7.5	R 7.5	R 7.5	R 7.5
Office costs (salaries & overhead	R 0.3	15%	R 0.3	R 0.3	R 0.3	R 0.3	R 0.3	R 0.4	R 0.5	R 0.6	R 0.6	R 1.3	R 1.3	R 1.4	R 1.4	R 1.4	R 1.4	R 1.4	R 1.4	R 1.4	R 1.4	R 1.4
IP costs	Rm			R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3	R 1.3
Net income	Rm		0	-R 1.6	-R 1.6	-R 1.4	-R 1.4	-R 1.0	-R 0.5	-R 0.1	R 0.3	R 3.9	R 4.4	R 4.8	R 4.8	R 4.8	R 4.8	R 4.8	R 4.8	R 4.8	R 4.8	R 4.8
Cumulative income			0	-R 1.6	-R 3.1	-R 4.5	-R 5.9	-R 6.8	-R 7.3	-R 7.5	-R 7.1	-R 3.2	R 1.2	R 5.9	R 10.7	R 15.5	R 20.3	R 25.1	R 29.9	R 34.6	R 39.4	R 44.2
IRR to institution							0%	0%	0%	0%	0%	-9%	2%	9%	13%	15%	17%	18%	19%	20%	20%	21%
Income as % Research					-1.6%	-1.4%	-1.4%	-1.0%	-0.5%	-0.1%	0.3%	3.9%	4.4%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%
Economic impact estimates																						
Turnover at average royalty rate	3%		0.0	0.0	0.0	6.7	6.7	23.3	40.0	56.7	73.3	215.0	231.7	248.3	248.3	248.3	248.3	248.3	248.3	248.3	248.3	248.3
GDP Multiplier	1.5		0.0	0.0	0.0	10.0	10.0	35.0	60.0	85.0	110.0	322.5	347.5	372.5	372.5	372.5	372.5	372.5	372.5	372.5	372.5	372.5
Tax revenue direct	30%		0.0	0.0	0.0	3.0	3.0	10.5	18.0	25.5	33.0	96.8	104.3	111.8	111.8	111.8	111.8	111.8	111.8	111.8	111.8	111.8
Indirect mulitplier	4		0.0	0.0	0.0	40.0	40.0	140.0	240.0	340.0	440.0	#####	#####	#####	#####	1490.0	1490.0	1490.0	1490.0	1490.0	1490.0	1490.0
Tax revenue indirect	25%		0.0	0.0	0.0	10.0	10.0	35.0	60.0	85.0	110.0	322.5	347.5	372.5	372.5	372.5	372.5	372.5	372.5	372.5	372.5	372.5
Net income			-100.0	-100.0	-100.0	-90.0	-90.0	-65.0	-40.0	-15.0	10.0	222.5	247.5	272.5	272.5	272.5	272.5	272.5	272.5	272.5	272.5	272.5
IRR - national									-	-	-	-	-3%	3%	7%	10%	11%	13%	14%	14%	15%	16%

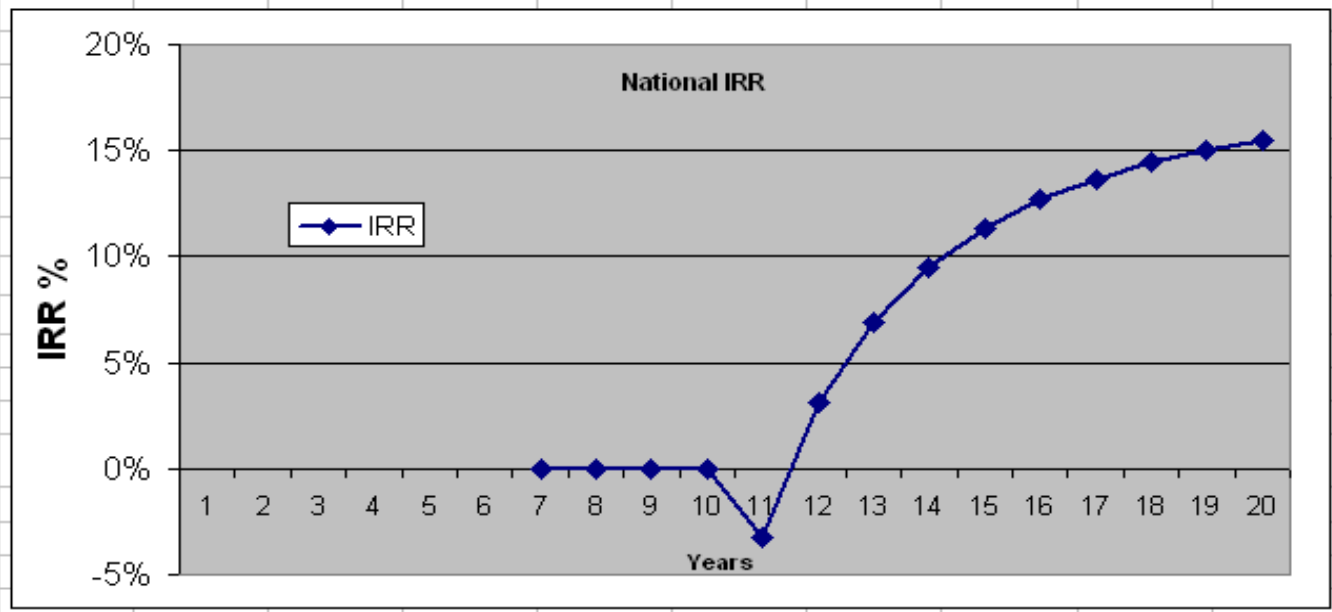
	Parameter	Years lag
Disclosure Rm	R 8.0	
Patents	50%	1
Average patent cost Rm	R 0.20	
Licences	20%	2
Licence period		7
	#	
Royalties Rm	R 0.20	3
Spin-outs	10%	4
Income from spinout Rm	R 3.0	5
Office costs (salaries & o/hs)	R 0.3	15%



Year	9	10	11	12	13	14	15	16	17	18
IRR (institution)	0%	-9%	2%	9%	13%	15%	17%	18%	19%	20%

Parameters:

Average royalty rate	3%
GDP Multiplier	1.5
Tax revenue direct	30%
Indirect mulitplier	4
Tax revenue indirect	25%



Go to model

Predicting performance … in 20 years time?

Abstracted data for a few countries with SA projections

		Disclosures		Licences/Patents			Spin-outs		Licence + Spin-out
	$Research	No	$Research /disclosure	#Licences/ disclosures	$Research /Licence	Income as % research	#Spin-outs/ disclosure	$Research /spin-out	
USA[1]	$29b	13,032	$2.3m	33%	$6m	4.5%	3.5%	$66m	37%
UK[2]	$2.6b	1,402	$1.8m	20%	$9m	1%	12%	$14m	32%
Canada[1]	$1.4b	875	$1.6m	15%	$10m	2%		$38m	
Australia[3]	$510m	274	$1.9m	23%	$8m		4%	$31m	27%
Scotland[4]	$347m	216	$1.6m	17%	$8m		5%	$17.6	
Europe[5]	$3.5b	1,522	$2.3m	16%	$14m	1.4%	17%	$13.2	33%
USA mid-50[6]	$4.5b	2,073	$2.2m	33%	$6m	1.7%	4%		37%

Projections to SA if operating at international norms (high/low ratios used)

		# disclosures	# patents/licences	Income	# Spin-outs
S Africa	$500m (ppp adjusted)	250 - 300	50 - 80	$3-$10m	10 - 50

1. Association of Unversity Technoloy Managers (AUTM) FY 2000 survey
2. UNICO-NUBS Survey on University Commercialisation 2001
3. Australasian Tertiary Institutions Commercial Companies Association Inc (ATICCA) 1988
4. Edinburgh University Research and Innovation Office (for 1999/2000)
5. The Association of European Science and Technology Transfer Professionals (ASTP) Feb 2001
6. AUTM survey mid-50% ($15m to $100m research expenditure universties & ignoring outliers)

Question #5

Dynamic economic model

- Is this useful?
- Can we make it more accurate?
- What are implications if it is correct?
- Is this extensible to new institutions and countries?

Question #5.1 – some answers

Dynamic economic model Is this useful?

- Yes, it explains why linkages, clustering, networking are so important
- It highlights key questions for developing countries about leakages
- It "numerates" institutional commitment
- It keeps you humble

Question #5.3 – some speculation

Dynamic economic model

What are implications if it is correct?

- **If any region or developing country does not have sufficiently high multipliers/linkages, then an investment in more research than is necessary for the production of students, has a negative economic impact**
- **The request for more funding for universities on the basis that this contributes to economic growth (through technology transfer) are false**

I'm a turkey that has voted for Christmas

… did the easy bit (a snapshot in time)

… then we did the hard bit (a dynamic model)

…now we get to the really hard part

Technology policy for a world of skew-distributed outcomes

F.M. Scherer [a,*], Dietmar Harhoff [b]

[a] Harvard University, John F. Kennedy School of Government, Cambridge, MA 02138, USA
[b] University of Munich, Munich, Germany

"The distribution of returns from individual technological innovations is quite skew — most likely adhering to a log normal law. A small minority of innovations yield the lion's share of all innovations' total economic value".

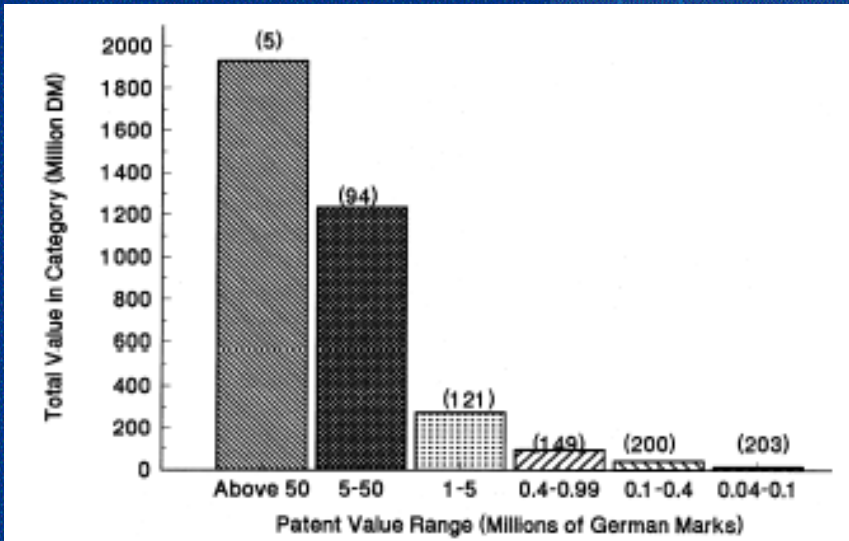


Fig. 1. Distribution of German patent values.

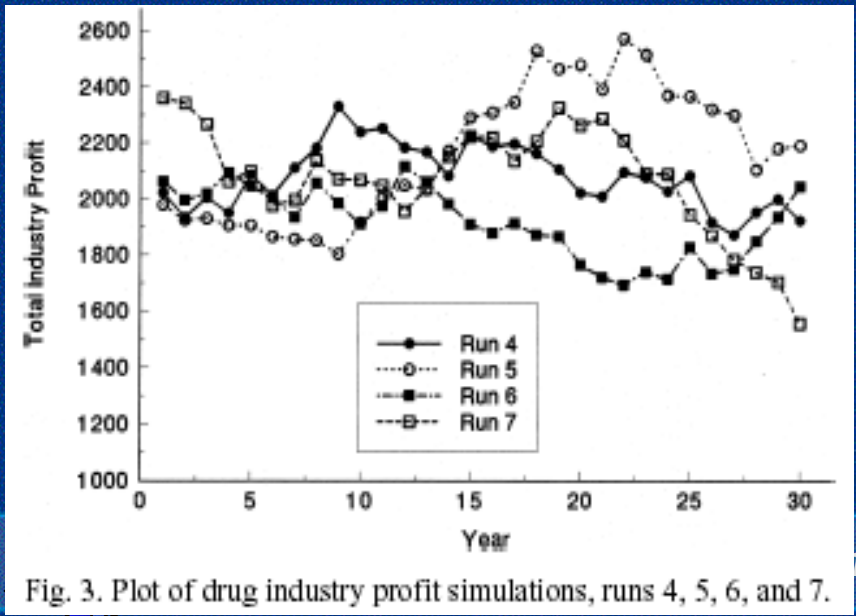
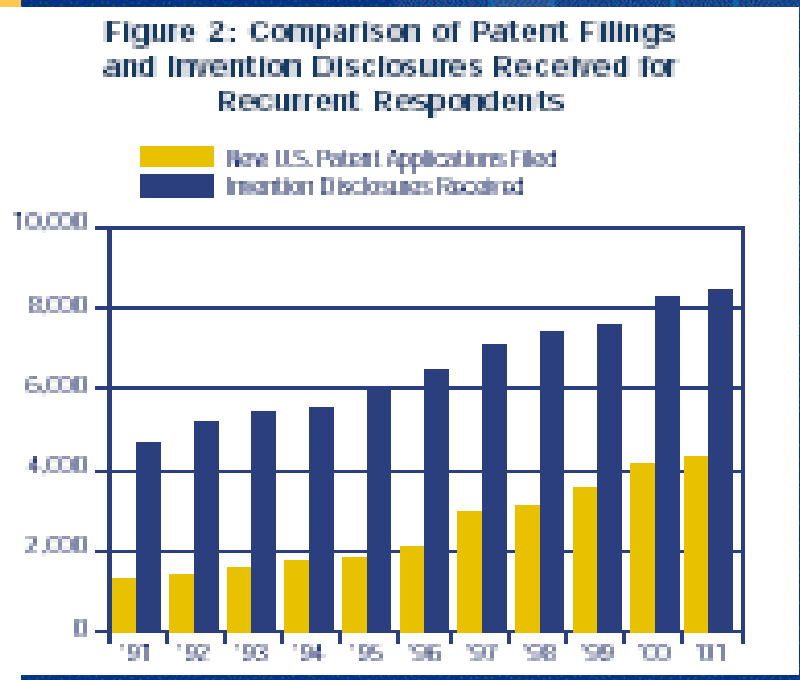


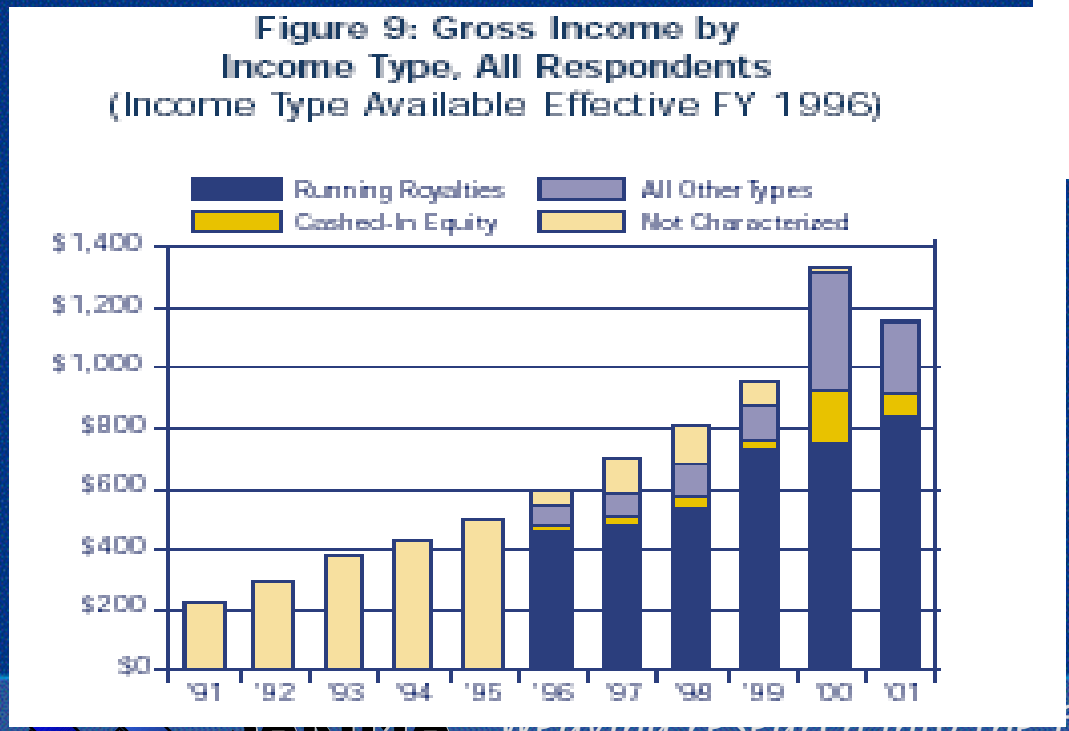
Fig. 3. Plot of drug industry profit simulations, runs 4, 5, 6, and 7.

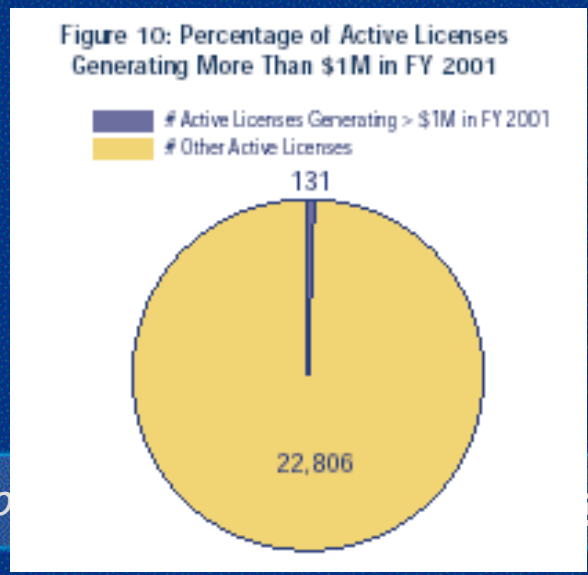
"The skewness of returns adds instability to the profit of whole industries and may extend even up to the macroeconomic level."

AUTM Licensing Survey: FY 2001

Survey Summary







Scherer & Harhoff … key points

- *"The distribution of returns from individual technological innovations is quite skew — most likely adhering to a log normal law.*
- *Difficulty in averting risk through portfolio strategies*
- *Assessing individual organizations' innovative track records is problematic.*
- *Public sector programs seeking to support major technological advances must strive to "let many flowers bloom"*
- *The skewness of returns adds instability to institutions, to the profit of whole industries and may extend even up to the macroeconomic level.*
- *Although much remains to be learned, some important lessons for technology policy have begun to emerge."*

Question #6

Variability of outcomes

- How do we manage?
- How do we prevent abuse?
- What are implications for smaller institutions and countries?

… and be very humble indeed… it is difficult

Variability implications for a small country?

Abstracted data for a few countries with SA projections

		Disclosures		Licences/Patents			Spin-outs		Licence + Spin-out
	$Research	No	$Research /disclosure	#Licences/ disclosures	$Research /Licence	Income as % research	#Spin-outs/ disclosure	$Research /spin-out	
USA[1]	$29b	13,032	$2.3m	33%	$6m	4.5%	3.5%	$66m	37%
UK[2]	$2.6b	1,402	$1.8m	20%	$9m	1%	12%	$14m	32%
Canada[1]	$1.4b	875	$1.6m	15%	$10m	2%		$38m	
Australia[3]	$510m	274	$1.9m	23%	$8m		4%	$31m	27%
Scotland[4]	$347m	216	$1.6m	17%	$8m		5%	$17.6	
Europe[5]	$3.5b	1,522	$2.3m	16%	$14m	1.4%	17%	$13.2	33%
USA mid-50[6]	$4.5b	2,073	$2.2m	33%	$6m	1.7%	4%		37%

Projections to SA if operating at international norms (high/low ratios used)

		# disclosures	# patents/licences	Income	# Spin-outs
S Africa	$500m (ppp adjusted)	250 - 300	50 - 80	$3-$10m	10 - 50

1. Association of Unversity Technoloy Managers (AUTM) FY 2000 survey
2. UNICO-NUBS Survey on University Commercialisation 2001
3. Australasian Tertiary Institutions Commercial Companies Association Inc (ATICCA) 1988
4. Edinburgh University Research and Innovation Office (for 1999/2000)
5. The Association of European Science and Technology Transfer Professionals (ASTP) Feb 2001
6. AUTM survey mid-50% ($15m to $100m research expenditure universties & ignoring outliers)

Observations

- There are large variations in institutional performance - for any country and whatever measure
- This is indicative of an immature profession where best practice is not known and many experiments are taking place
- Europe, UK and USA can afford the luxury of this "inefficient" experiment!
- Developing countries cannot – with limited resources we have a pressing need to find out what is best (most appropriate) practice …and apply it

Why Technology Transfer?

- To reward, retain and recruit faculty
- To induce closer ties to industry and produce more 'entrepreneurial' students
- To extract benefit from research for public good
- To promote economic growth
- To generate income

Knowledge tranfer into civil society

- Innovation in health, education, justice, and others is as essential as innovation in hard sciences.
- Our civil society problems arise largely from past neglect, poor policy, misapplied resources, etc (sometimes malign, but mostly benign.)
- The solutions to these issues need to be (can only be?) found and implemented by the people who are effected – cultural immersion
- Diversity of the research work-force is not just an equity issue, it is essential for execution

BUT civil society innovation is a much more difficult and complex than technology transfer,.. or academic publishing.

Paper Prepared for the TIPS/DPRU Forum Sept 2003.

The Challenge of Growth and Poverty: The South African Economy Since Democracy

Professor David Kaplan
Science and Technology Policy Research Center
Department of Economics
University of Cape Town

TABLE 15. CONSTRAINTS ON INVESTMENT					
Factor	No effect	Very little effect	Moderate effect	Strong effect	Prohibitive
	% response				
The general political climate	16	30	31	22	2
Government economic policies	6	17	36	38	3
Labour regulations	4	11	26	47	12
Cost of labour	4	11	29	48	7
The availability of skilled labour	14	26	32	24	4
The cost of capital & concerns about the interest rate	3	10	30	47	9
Corporate tax rates	5	19	40	33	4
Insufficient demand for your product/poor outlook for sales	6	15	23	42	13
Growing competition from imports	12	21	24	37	6
Fluctuations in the exchange rate	2	8	27	52	12
Crime	5	18	33	34	10
Aids	9	29	37	21	5

Dave Kaplan, TIPS Sept 2003

"**The first observation** is that .. none of the major constraints on business investment can be addressed **directly** by **the dti**. Policies designed to mitigate the major constraints on business investment all fall within the mandate of other government departments.

The second observation is that while we can identify, in broad terms, the major current constraints…, we need far more information and analysis…We need to understand much more about the precise nature of the constraint and its impact…. on policies effected elsewhere in government…"

Dave Kaplan, TIPS Sept 2003

Question #7

Innovation in civil society

- How to define the need? (e.g Kaplan)
- What can be done?
- Who should be involved?
- How do you get them to particpate?

Question #7 – a suggestion

Innovation in civil society

Ask the question:

- Is this research of interest to anyone?
- How could this benefit be realised?

… and keep asking until you get an answer

(***and if the answer is no, and you are not a Nobel laureate in the making, maybe you should be doing something else.***)

Conclusions and implications for developing countries

(*and maybe in developed countries as well*)

- Portfolio strategy **may** be possible at national level, but is not possible for individual institutions
- Institutions take on risk (with uncertain outcome) with benefits (if any) captured largely at national level
- "Institutional commitment" is a key – but we don't know how to measure of change
- Professional research & innovation offices with trained staff are essential. **Either do it professionally or not at all.**
- These staff need not only to **do their job**, but also **do research** into what they do – in a partnership with Globelics?
- A 'believable' model based on real data would be of benefit for both institutional planning and evaluation of alternative institutional and national scenarios

Tony Heher, Director, UCT Innovation
University of Cape Town, South Africa
Tony.Heher@UCT-Innovation.co.za
and Past President of SARIMA

… the newest kid on the Globelics block …and a humble, aspirant, Afro-holic