Patent Systems:
Does One Size Really Fit All?

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September 14, 2008

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The concept of an international patent system with common requirements and application processes has been with us for some time and is intuitively quite appealing. From the GATT negotiations to the WTO to the current day, countries have looked to work together to ease the myriad problems posed by idiosyncratic national patent systems. But beyond the attractions of an international harmonization of patent systems, there are also some concerns. This paper looks to examine these concerns and available data that shed light on their validity. There is also a case to be made that these idiosyncratic national systems may have developed in the manner they did for a good reason, and countries and regions should at least reflect on the impact of a dramatic change in patent procedures before jumping to a more harmonized international standard.

This paper reviews some theory concerning the purpose and function of patent systems, then moves to comparisons of some of the prominent national innovation systems and their associated patent processes. In making an informed decision on how to structure and administer patent systems, it's generally a good idea to go back to the basics: essentially what is a patent system designed to do and who is it designed to do it for? We'll cover these questions and try to shed some light on what the important indicators might be in trying to justify the move to a more harmonized international system (or not).

Given the author's familiarity with the US patent system, the emphasis will be there, using the US model as a reference for other systems. Even with this parochial emphasis, the paper will use extensive international data for comparisons of the US with other systems.

Background

Theory concerning patents systems goes back centuries, including a mention in the US constitution ensuring that artists and scientists receive the fruits of their labours. Economic theory concerning patents also goes back a long way but serious work on the core economics of the tool really started with Plant (1934). From there, a great deal of conceptual work has gone into capturing the role of a patent system as a means to encouraging innovation in an economy. Issues such as the length of the protection term and the breadth of its coverage have been studied at length, with the implicit or explicit objective of determining the "optimal" patent system for generating specific innovation outcomes (more innovations (quantity) and/or bigger innovations (quality)) (Scotchmer 1991, Gilbert & Shapiro 1990, Klemperer 1990). While useful in terms of setting the terms of the debate and providing overall guiding principles to designing, administering, and amending a patent system, such work is often too theoretical to be of much practical help with more mundane patent system decisions.

Of more use to the more data-driven analysis at the core of this paper, however, is the branch of study that began in the 1980's and 1990's concerning national innovation systems (NIS) (Nelson 1993, Nelson 1984, Rosenberg 1982). The concept of the NIS is that nations provide environments for their firms to compete in international markets (the competitiveness of nations) and that the NIS, in particular, is the environment affecting the generation and development of innovation. The spur for the field's development was the fairly obvious observation that nations had different levels of success in producing innovations, whether measured in terms of patents, production of high-technology goods and services, trade in high-technology goods and services, or other metrics (Mowery & Teece 1993, Mowery 1992, Patel & Pavitt 1987). Researchers in the field looked to the variables affecting the success of these NIS in accomplishing these objectives. Variables included things such as R&D spending (private or public, antitrust law, potential market size, education and the labour force, and, of course, the nature of the patent system.

The real spur for these studies were the concerns among US and European scholars and policymakers that Japanese innovation and manufacturing might be leaving them behind in the early nineties. While perceptions have changed dramatically in the years since, it is still a legitimate question for business, government, and academia. Are there better systems for generating national innovative output? If so, what might the components be? What components work best with one another? Although it is difficult to home in on a specific component of a national innovation system and directly measure its impact on innovative output, it is possible to evaluate overall systems quantitatively and then make judgements about success and the contributions some of the components make to relative success or failure. Indeed, one can assess whether a specific component, such as a patent system, "fits" with the rest of the NIS.

In terms of patents, differences between the two extremes among more developed countries of the US system and the Japanese system are so well known to academics and practitioners working in the field that the details are sometimes "described in shorthand" (Hearing 1992, Helfgott 1990). This view will be developed in more depth later in this paper, but he difference is essentially between a US system with broad, strong protection and minimal administrative procedures and a Japanese system with narrower, weaker protection and a sometimes difficult administrative system of challenges. The European system(s) are typically seen to be somewhere in between. And the differences in systems are often associated with different results in terms of type of innovation (pioneering vs. me-too or incremental) and the nature of the participants (large corporations vs. individual inventors or something in-between). It's obviously hard, probably impossible to prove causation of patent systems and such results, but it's not unfair to subjectively assess the fit of the patent system with an overall NIS that seems to generate these outputs.

So what can we tell about National Innovation Systems and their associated patent systems from available data that will shed light upon the the relative success of each? One approach is to look at the nature of technological output. A natural objective of a patent system is to fit with the NIS as it supports innovation efforts by its stakeholders, especially its domestic community. We'll look at several variations on evaluating technological output. As an extension of that, there are different types of technological output, and we can similarly evaluate whether and how disparate systems contribute to these different outputs. As just noted, sometimes the NIS and patent system support different innovation cultures and can and probably should generate varying results. Finally, a key question is who the NIS and associated patent system is designed to serve. All sorts of innovators make use of a patent system but not all benefit from the same degree and not all are served by the specific requirements and administration of a given system.

National Technological Output

Assessing the technological output of nations is an exercise with a lengthy history among scholars and policy makers. Economists, in particular, have developed quite a literature dealing with national technological output. In some cases, this has included indirect measures such as Solow's (1957) remainder from the aggregate production function. But more recent work has focused on more direct measures. And first and foremost among these are patent statistics. Patents are popular simply because they are so available, by definition they directly measure technology, and are generally objective metrics that change slowly over time (Griliches 1990). But there are issues. The amount of technology contained in a patent can vary dramatically by country and industry. There are also considerable differences between industries and even firms within industries in how much patents are used vs. other protection alternatives (trade secrecy, moving quickly down the learning curve, etc.) (Levin, et. al.

1987). Patent levels can also change over time because of issues having little to do with technology, including support for patentees in the courts (Shapiro 1990) or the patent office's budget and workload (Griliches 1989). That being said, patents can provide useful insights, especially when used with other indicators.

The question then becomes what patents to use as indicators. US patents have often been used since the US has been the largest national market for most products—hence the assumption that just about any innovation of any importance will likely head for the US market and will often be protected by a patent (Glismann & Horn 1988). The data are also quite available, detailed, and reliable (Soete 1987). Any national patent system, however, will tend to both favour its own inventors in its count and will contain a certain amount of "fluff" in the form of patents with relatively little underlying technology as domestic inventors pursue less important or even vanity patents that would never be taken across borders (Pakes & Simpson 1989, Patel & Pavitt 1987). In spite of this, the European Union, especially Germany, has also been a popular source for patent statistics as has Japan with the same advantages and disadvantages. Even with these cautions, consider Table 1 which presents patent levels from this global triad. South Korea is also included as something of a control, the largest patentee outside of the triad and thus a country for which all of these filings are non-domestic.

Table 1
National Patent Applications
(NSF 2008)

	2005 Number of Apps	2005 Percentage	1995 Number of Apps	1995 Percentage	1985 Number of Apps	1985 Percentage
USPTO						
US	207,867	53.2	123,958	58.4	63,874	54.6
EU	52,323	13.4	31,277	14.7	24,523	21.0
Japan	71,994	18.4	39,872	18.8	21,431	18.3
Korea	17,217	4.4	2,820	1.3	129	0.1
EPO						
US	32,064	26.0	21,644	30.8	11,635	27.1
EU	52,255	42.3	31,093	44.3	21,517	50.1
Japan	22,123	17.9	12,523	17.8	6,617	15.4
Korea	4,926	4.0	459	0.7	18	0.04
JPO						
US	36,658	9.2	30,515	8.7	34,689	11.7
EU	25,453	6.4	12,906	3.7	12,253	4.1
Japan	286,082	71.9	269,932	76.8	226,202	76.1
Korea	6,270	1.6	1,691	0.5	89	0.03

As with all the data to follow, such results need to be interpreted with some care. All nations/regions patent more heavily in their own home patent office, though the relatively larger US market draws a lot more attention from foreign patentees than does the relatively smaller (and more closed) Japanese market. Population obviously matters. There are also differences in the percentage of patents taken abroad, often indicative of more important patents. The Japanese percentage is much higher for both foreign destinations while the European percentage is high for the US but low for Japan, again probably indicative of the size of the target markets. Conversely, the Korean numbers suggest a similar attraction for the US market as well as a seemingly higher desire to enter the Japanese market. But there is considerable literature and research showing that Japanese patents tend to be much narrower in scope and, hence, the Japanese tend to file numerous patents which might be covered by only a single patent in Europe or, especially, in the US. This factor tends to inflate Japanese patent numbers, especially at home. Foreign filings are often inflated as well. Balancing that is the smaller Japanese population. National patent numbers have some interesting results but are generally open to interpretation when used without other indicators. What they do suggest unequivocally, however, is that broad differences exist between the systems and the results generated by them in terms of number of patents and participation by domestic and foreign patentees.

As a consequence of the issues with national patents, some researchers have looked to international patent counts, generally by combining national counts in some way (Nelson 1990, Fagerberg 1987). This can also pose some difficulty as patent systems can differ in the standards applied to patent grants, 93% accepted in France and about a third in Germany (Schankerman & Pakes 1986) vs. 60-70% in the US (Griliches 1990), proportion of domestic patents, and in the amount of technology contained within a typical patent. Methodologies such as Fagerberg's of adding up patents from the global triad while subtracting out domestic patents (e.g. for the US, adding Japanese and EU applications or grants while not including US) raise some obvious concerns since the nature of the excluded domestic patents can differ dramatically and importantly. And, perhaps most difficult of all, patentees in specific EU countries don't necessarily seek out the common application at the EPO. One new development is the ability to track only patents filed in all three venues. This approach has a number of positive aspects to it as it eliminates the domestic biases while identifying particularly important patents. There are still issues as some countries are more export-oriented than others and thus more inclined to patent across borders. And some patents are sought in individual EU countries but not at the EPO. But the data are still of interest. Triad application counts, percentages, and applications per GDP and per domestic R&D spending are presented in Table 2.

Table 2
Triad Patent Applications
(NSF 2008)

	2005 Apps	2005 %	2005 App/GDP	2005 App/R&D	1995 Apps	1995 %	1995 App/GDP	1995 App/R&D	1985 Apps	1985 %
US	16,368	30.96	1.5	0.09	12,020	34.4	1.5	0.11	7,781	34.0
EU	14,988	28.35	1.3	0.14	11,533	33.02	1.3	0.17	8,463	37.02
Japan	15,239	28.83	4.4	0.19	9,429	7.0	3.0	0.16	5,335	3.3
Korea	3,158	5.97	3.3	0.16	324	0.9	0.5	0.03	8	0.03

These data give a more reliable view of national technological output, reducing the bias of national patent systems though not entirely eliminating it. There are still issues with destination market size (raising non-US and non-EU numbers relative to Japan) and with breadth vs. narrowness of patents (also raising Japanese and, perhaps, the Korean numbers). Population is again an underlying factor. This approach does, however, eliminate the “fluff” domestic patents that don't necessarily reflect important underlying technologies. Further, the data do show some sense of the success of all three major parts of the global triad. Further, some other readily available data break down the triad applications as a GDP and and GERD (gross expenditure on industrial R&D). The first starts to compensate for some of the population differences and would compensate for different levels of development, if necessary. The second begins to move toward an input/output framework (technological output generated by R&D spending input), something beyond the limits of this paper, but one that has emphatically shown national differences in technological output in the past (Erickson 1994) and can add further depth to any of the output indicators.

Beyond patents, several other options for assessing technological output exist. One approach is to identify high-technology industries (usually subjectively) and assess output, exports, and imports (Soete 1987). Another option is royalty receipts and payments for licensed technology (Archibuigi

1988) These data, in fact, are now routinely tracked in governmental and other statistics, as in Table 3 which includes value added output in goods and services, gross revenues, exports, and imports.

Table 3
Other Technological Output Measures
(NSF 2008)
(*millions of 2000 US$)

	2005		1995		1985	
Value-Added Knowledge-Intensive Services*						
US						
EU	3,907,680		2,738,873		2,142,758	
Japan	2,540,813		1,892,124		1,310,847	
Korea	1,128,539		739,518		450,381	
	136,185		92,936		27,727	
Value-Added High-Tech Mftg*						
US	414,209		159,170		149,692	
EU	221,115		147,969		114,602	
Japan	194,395		165,980		113,904	
Korea	43,562		16,620		2,595	
High-Tech Exports & Imports*	**Exports**	**Imports**	**Exports**	**Imports**	**Exports**	**Imports**
US	262,091	396,744	136,953	132,056	52,334	46,195
EU	257,417	382,365	108,131	123,332	42,610	43,546
Japan	204,742	124,887	105,410	44,670	47,487	9,261
Korea	126,138	73,288	24,852	21,024	4,098	4,125
High-Tech Gross Rev*						
US	932,864		358,048		262,476	
EU	650,268		417,241		312,348	
Japan	502,369		427,305		289,161	
Korea	163,144		54,372		9,325	
High-Tech Share of Exports					**(1990)**	
US	35.8		32.6		33.6	
EU	22.1		17.0		14.8	
Japan	28.9		31.9		30.4	
Korea	36.1		29.2		---	
US Royalties*						
US Receipts	57,410		30,289		8,113	
US Payments	24,501		6,919		1,401	
Balance	32,909		23,370		6,712	

With these results, a somewhat different picture begins to emerge. There are still concerns, as the obvious question is what is "high-tech" while the obvious answer is that it tends to be pretty subjective, depending on who might be making up the list. There also appear to be some inconsistencies in some of the data (the US share of "gross revenues" increases dramatically over the period in question with no good explanation). That being said, these data get away, somewhat, from the issues with patents as consistent indicators of technological innovation—there are definitions and, even when subjective the definitions are consistent. Population and GDP differences remain. As noted, however, we now have a new perspective as a number of these measures start to show US output of technology to be at an apparently higher level than other parts of the triad. The one real exception is in the export/import comparison. The US clearly generates more value-added services and more value-added high-technology manufacturing, at least in 2005. High-tech gross revenues are also higher, and the percentage of exports geared to high-technology is significantly larger. Royalty payments into the US are more than double the level of royalty payments out. All indicators suggest a US system that does a good job of generating high-value innovative products of value in international markets, more so than other countries. All indicators except the export/import balance, as noted, but there may be issues there, once again, in terms of a unique definition of high-technology and/or the biases of the US market having the greatest profit potential for most innovative products.

As a check on these thoughts and the data, consider another set of indicators, this time from a different source, the OECD. These data are presented in Table 4.

Table 4
Even More Technological Output Measures
(OECD 2008)

	Technology Balance of Payments (millions of US $)			Trade Coverage Ratios (Exports/Imports)		Export Market Share % of OECD	
	Receipts	**Payments**	**Balance**	**High-Tech**	**Medium High-Tech**	**All Mftg**	**High-Tech Mftg**
US	57,410	24,501	32,909	78	67	13.7	19.5
Germany	31,636	28,264	3,371	109	210	15.2	12.5
UK	29,206	14,418	14,787	100	80	5.7	7.2
Japan	18,403	6,385	12,018	138	372	9.5	10.4
Korea	816	3,327	(2,421)	172	158	4.8	6.9

One metric repeats the import/export balance we just discussed, but a quick glance at the magnitude of the numbers shows a much more restrictive definition of high-tech and a much different picture as the US sports a substantially higher positive difference than the other countries noted (and previously dominant Japan has a much smaller difference). This seeming inconsistency with the previous data is probably due to a commonly noted difference between the innovation systems, with the US system generating relatively more pioneering or breakthrough innovations and the Japanese system generating relatively more me-too or incremental innovations.   There is essentially more technology in the US innovations, on average. This perception is validated in the final two columns of the table, wherein the US export percentage of high-technology exports is highest and partially validated by the preceding two columns. In trade coverage, the US ratios are again relatively low, as with the previous NSF data. The ratios are, however, higher for the high-technology exports and also closer to the ratios of the other countries.

Finally, extensive data also exist concerning who uses the patent systems of different nations. While those data are a little harder to come by and haven't been updated and reproduced here, the bottom line is that the US patent system has a much higher percentage of participation by individual inventors and small businesses (Erickson 1996a). Further, the percentage of inventors in the US and most other more developed countries who take their patents abroad is fairly small, as can be discerned from Table 1. Particular aspects of the US system, the broader protection and the less cumbersome administrative procedures, especially challenges/oppositions, tend to lend themselves well to the smaller inventors, less so to multinationals patenting across borders.

Discussion

These recent data confirm previous studies concerning the technological output of nations which appear to be correlated with aspects of their national innovation systems. We just noted the tendency of US participants to relatively more of the high risk, high reward pioneering innovations, the Japanese and other growing Asian nations to lower risk, lower reward incremental innovations, and of European nations to something in-between (Erickson 1995, Mowery & Teece 1993, Nelson 1990). These circumstances square with other things we know about these nations, including attitudes toward and the presence of entrepreneurs and risk-takers, competition or cooperation among firms, and other such aspects of economic culture that define the circumstances under which innovation takes place. The US is more of an individual culture with risks and rewards for unique visions. Japan is more communal and cooperative with a reward system more geared toward low risk and cautious change. Neither is necessarily good, bad, or better than the other, but they do lend themselves to different inputs to innovation and different outputs (Erickson 1996b).

And what does this have to do with a patent system? The patent systems of these countries work best when they "fit" with the rest of the national innovation system. All by themselves, a patent system will not have a tremendous impact, the nature of the system will affect technological output—positively when it matches the other aspects of an NIS, negatively if it does not. The idiosyncrasies of patent systems have developed over decades and are not there by accident, they evolved to fit specific economic cultures. The impact of a change in a patent system is hard to assess as one hardly ever has an identifiable major change that can then be linked to a specific outcome. But Stamm's (1991) study of the Italian system showed 1800% growth in investment in pharmaceuticals over two decades against only 400% growth in chemicals following a very specific patent system change firming up protection for the former but not for the latter. Similarly, though not as clearly linked, the US saw a surge in patenting activity in the 1980's following a tightening of patent protection that included a dedicated Federal Appeals Court for patent disputes (Shapiro 1990). The nature of the patent system has an impact on innovation activity.

And this is very clearly seen in the way a patent system will often match a specific NIS (Erickson 1999, Erickson 1996b). Again, this is most clearly seen in comparing the US and Japan. The US patent system has included the first-to-invent priority claim basis, broader patent grants with multiple claims, minimal administrative challenges (e.g. pre-grant oppositions), a specialized and independent court favourable to patent holders, and a number of other specific pieces that tend to encourage the bigger innovations we have been discussing. Alternatively, the Japanese system encourages quick filings (first-to-file priority claim basis), narrower grants with fewer claims, numerous administrative procedures competitors can use to hold up a patent or force cross-licensing (oppositions, patent flooding), and an appeals process run by the JPO itself. As noted, the European systems tend to fall somewhere in between.

And, again, this conclusion shouldn't be taken as any conclusion of a better or worse patent system, in general, but whether a patent system fits well with the economic culture of the country in question. The US patent system fits the US economic culture. The Japanese system fits the Japanese economic culture. For some countries, looking to import technology more than to create it, an entirely different structure might be appropriate. The key is to understand what outputs fit the economic culture and design the system to help generate those outputs.

Thus, the US model generates all sorts of technological innovation but tends to broader innovation. We have seen this in the national technological indicators. It also encourages a more entrepreneurial type of innovation and participation from different types of innovators. This includes almost twice as many small entity inventors than comparable countries (Erickson 1996a). Alternatively, the Japanese model generates narrower innovation, more cooperation between corporations, and very few small entity inventors. Both have been very successful with technological innovation, of albeit different types, and have systems that fit with their specific approaches.

Conclusions

This paper has reviewed data on the technological innovation of nations and the national innovation systems behind those numbers. Although not always consistent, the data are very clear in establishing that the nature of innovation differs across the global triad of the US, the EU, and Japan. The data would, of course, be even more different if more countries and regions were included. What accounts for the differences?

A great deal of theory suggests that it is the various NIS. Clear differences exist across countries in relation their innovation environments and these would appear to have a relationship to the output results we see. And consistent innovation environments are apparently more successful in generating the desired type of technological output, whatever that may be. Patent systems are one piece of an NIS and have evolved with the innovation systems of the major trading nations. Even a cursory review of the systems, especially using the extremes of the US and Japan as we did, suggests that specific aspects of the patent systems do have a fit with the NIS of which they are a part.

The conclusion is not that patent systems can't be changed and better harmonised across nations. Aspects that are clearly discriminatory, such as the US requirement for domestic proof of conception, should go, as should those that no longer work as desired such as the infamous US submarine patents. Patent systems can and should be better harmonised across borders. But change of other pieces of patent systems, those that might be ingrained in a national economic culture, should be undertaken much more carefully.

References

Archibuigi, D. (1988) "In search of a useful measure of technological innovation (to make economists happy without discontenting technologists)," *Technological Forecasting and Social Change*, 34, 253-277.

Erickson, S. (1999) "Patent law and new product development: Does priority claim basis make a difference?" *American Business Law Journal*, 36(2), 327-347.

Erickson, G.S. (1996a) "Environment and innovation: The case of the small entity," *Industrial Marketing* Management, 25(6), 577-587.

Erickson, G.S. (1996b) "Patent systems and economic culture: The Japanese patent system," *Asian Journal of Marketing*, 5(1), 7-22.

Erickson, G.S. (1995) "Generating national technological output: The influence of a national patent system," *Advances in Competitiveness Research*, 3(1), 86-109.

Erickson, G.S. (1994) "International indicators of the quality of technological output," *Journal of Global Competitiveness*, 2, 425-436.

Fagerberg, J. (1987) "A technology gap approach as to why growth rates differ," *Research Policy*, 16, 87-99.

Gilbert, R. & C. Shapiro (1990) "Optimal patent length and breadth," *RAND Journal of Economics*, 21(1), 87-99.

Glismann, H.H. & Horn, E. (1988) "Comparative invention performance of major industrial countries: Patterns and explanations," *Management Science*, 34(10), 1169-1187.

Griliches, Z. (1990) "Patent statistics as economic indicators: A survey," *Journal of Economic Literature*, 28(December), 1661-1707.

Griliches, Z. (1989) "Patents: Recent trends and puzzles," *Brookings Papers on Economic Activity: Microeconomics*, 291-330.

Hearing before the subcommittee on foreign commerce and tourism of the committee on commerce, science, and transportation, US Senate (1992) *Effect of the Japanese patent system on American business*. Washington, DC: US Government Printing Office.

Helfgott, S. (1990) "Cultural differences between the US and Japanese patent systems," *Journal of the*

Patent and Trademark Office Society, 72 (March), 231-238.
Klemperer, P. (1990) “How broad should the scope of patent protection be?” *RAND Journal of Economics*, 21(1), 113-130.
Levin, R.C., A.K. Klevorick, R.R. Nelson & S.G. Winter (1987) “Appropriating the returns from industrial research and development,” *Brookings Papers on Economic Activity*, 3, 783-381.
Mowery, D.C. (1992) “The US national innovation system: Origins and prospects for change,” *Research Policy*, 21, 125-143.
Mowery, D.C. & Teece, D.J. (1993) “Japan's growing capabilities in industrial technology: Implications for US managers and policymakers,” *California Management Review*, 35 (Winter), 9-34.
National Science Foundation (NSF) (2008) *Science & Engineering Indicators – 2008*. Washington, DC: US Government Printing Office.
Nelson, R.R., ed. (1993) *National innovation systems: A comparative analysis.* New York: Oxford University Press.
Nelson, R.R. (1990) “US technological leadership: Where did it come from and where did it go?” *Research Policy*, 19, 117-132.
Nelson, R.R. (1984) *High technology policies: A five-nation comparison.* Washington, DC: American Enterprise Institute for Public Policy Research.
Pakes, A. & M. Simpson (1989) “Patent renewal data,” *Brookings Papers on Economic Activity: Microeconomics*, 331-401.
Patel, P. & Pavitt, K. (1987) “Is western Europe losing the technological race?” *Research Policy*, 16, 59-85.
Plant, A. (1934) “The economic theory concerning patents for inventions,” *Economica*, (February), 30-51.
Rosenberg, N. (1982) *Inside the black box: Technology and economics.* Cambridge: Cambridge University Press.
Schankerman, M. & A. Pakes (1986) “Estimates of the value of patent rights in European countries during the post-1950 period,” *The Economic Journal*, 96, 1052-1076.
Scotchmer, S. (1991) “Standing on the shoulders of giants: Cumulative research and the patent law,” *Journal of Economic Perspectives*, 5(1), 29-41.
Shapiro, A.R. (1990) “Responding to the changing patent system,” *Research-Technology Management*, (September/October), 38-43.
Soete, L. (1987) “The impact of technological innovation on international trade patterns: The evidence reconsidered,” *Research Policy*, 16, 101-130.
Solow, R.M. (1957) “Technical change and the aggregate production function,” *Review of Economics and Statistics*, 39, 312-320.
Stamm, O.A. (1991) “GATT negotiations for the protection of new technologies,” *Journal of the Patent & Trademark Office Society*, (September), *680-699.*