International Patent Protection: 1990 - 2005

- Measurement and Trends

- Patent Strength and Stages of Economic Development

I. Measurement & Trends

- Patent Rights Index (0 - 5)

  - Duration (0 - 1)

  - Coverage (0 - 1)

  - Restrictions, if any (0 - 1)

  - Enforcement Mechanisms (0 - 1)

  - Membership in International Treaties (0 - 1)

Duration

- Application-Based Systems: 20 Years

- Grant-Based Systems: 17 Years

Coverage

- Pharmaceuticals
- Chemicals
- Food
- Surgical Products
- Microorganisms
- Plant & Animal Varieties
- Software
- Utility models (Petty patents)

Restrictions, if any

- Working Requirements

- Compulsory Licensing

- Revocation

Enforcement Mechanisms

- Preliminary Injunctions

- Contributory Infringement

- Burden-of-Proof Reversal

Membership in International Treaties

- Paris Convention

- Patent Cooperation Treaty

- UPOV (New Varieties)

- Budapest Treaty (Microorganism Deposits)

- TRIPS

Sample:

	1990	Rank	2005	Rank
United States	4.68	1	4.88	1
France	3.88	8	4.67	5
Japan	3.88	9	4.67	6
United Kingdom	4.34	3	4.54	11
Germany	3.97	6	4.50	14
Korea (South)	3.69	12	4.33	18
China	1.33	93	4.08	34
Mexico	1.36	91	3.88	39
India	1.03	105	3.76	41
Brazil	1.28	94	3.59	49
Cameroon	1.90	52	3.06	71
Thailand	1.21	97	2.66	96

Correlations with Patent Rights Index:

|	
World Economic Forum Intellectual Property Index	0.62
Enforcement Effectiveness, USTR (Park and Lippoldt, *OECD Economic Studies* 2005)	0.69
Mansfield (1994) IFC DP#19, World Bank, 16 Country Survey	0.53
Sherwood (1997) *Journal of Law & Technology*, 18 Country Survey	0.71

Figure 1. Strengthening of Patent Rights by Income Group

Figure 1. Strengthening of Patent Rights by Income Group
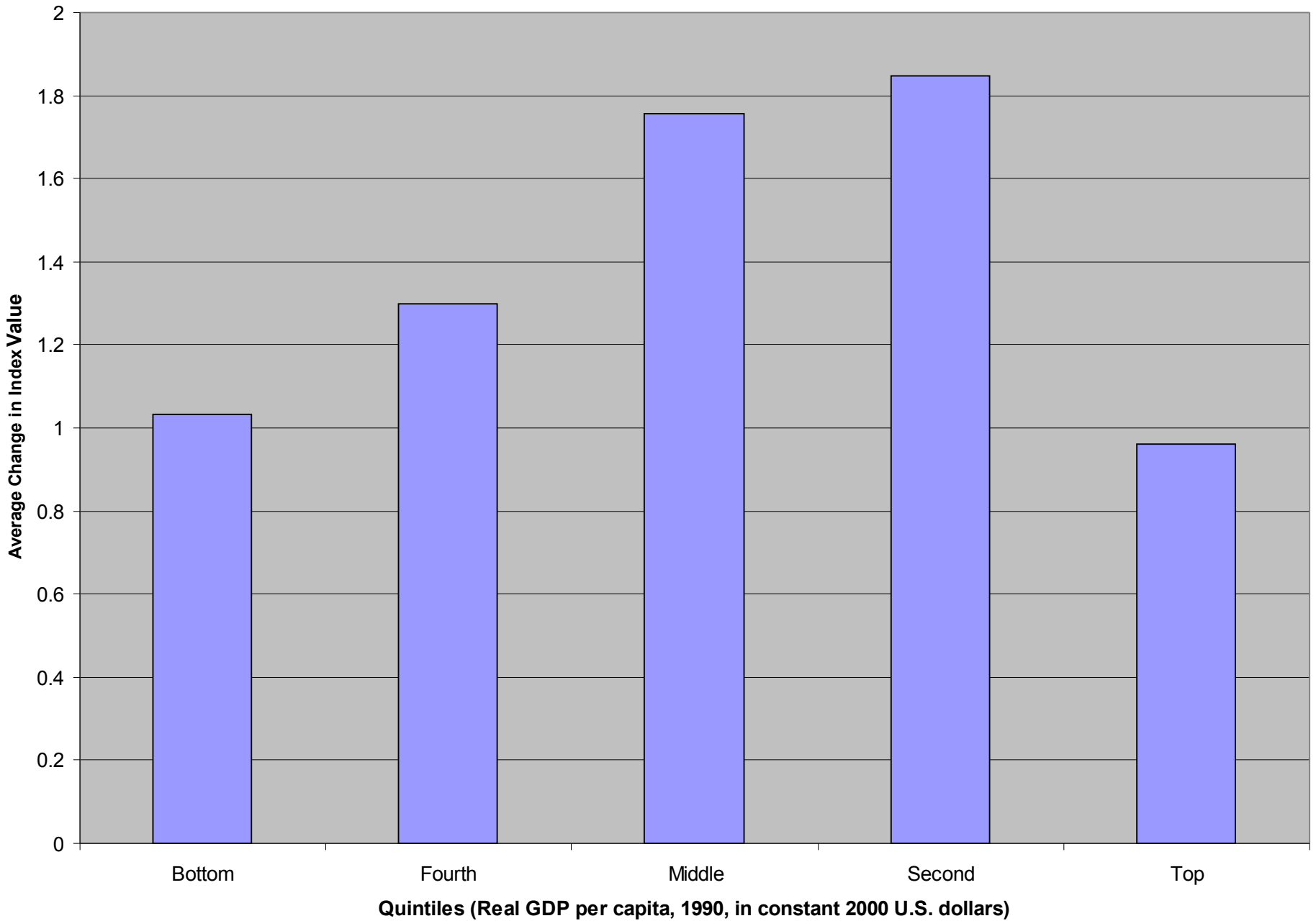
Figure 2. Increase in Duration by Income Group
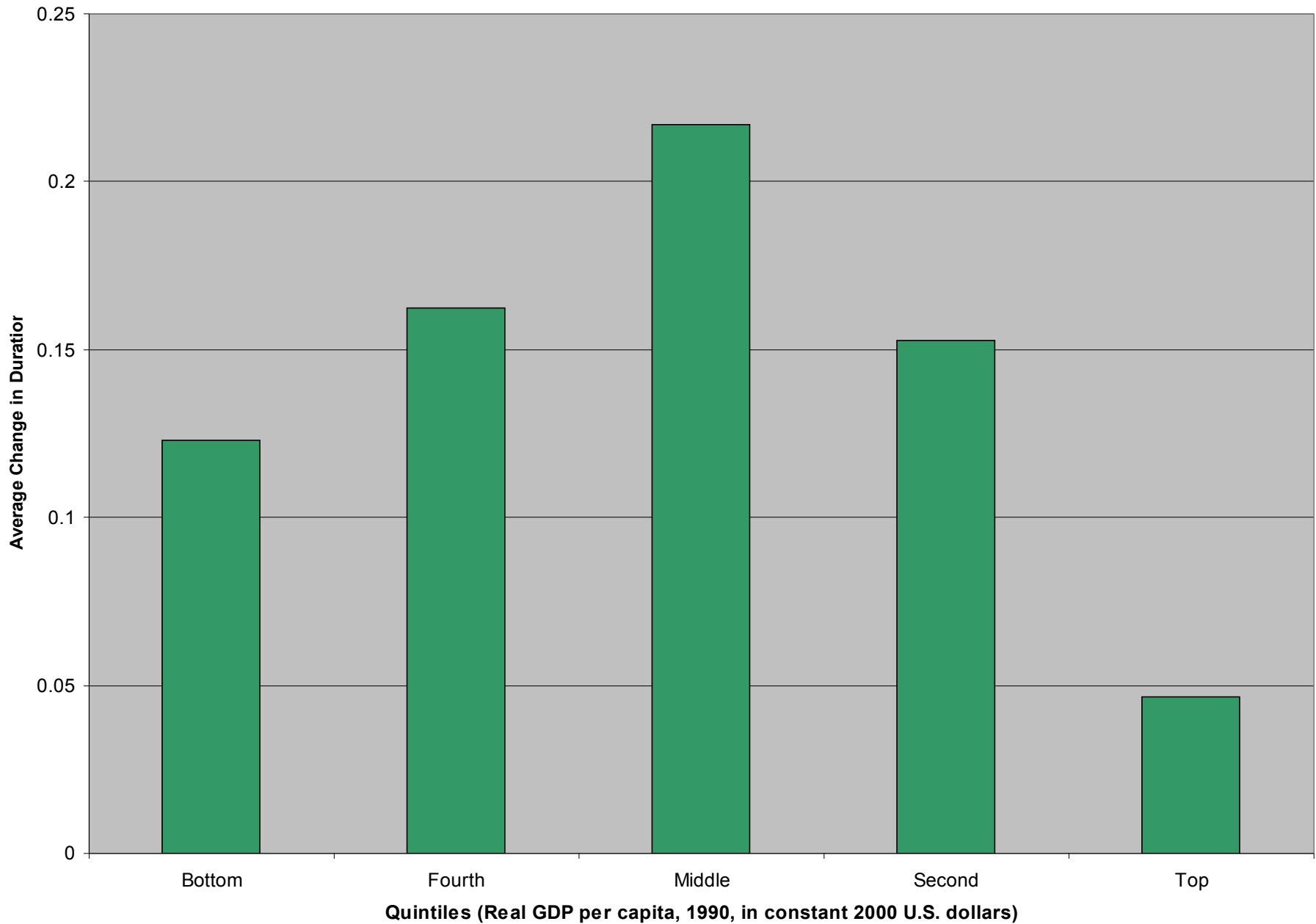
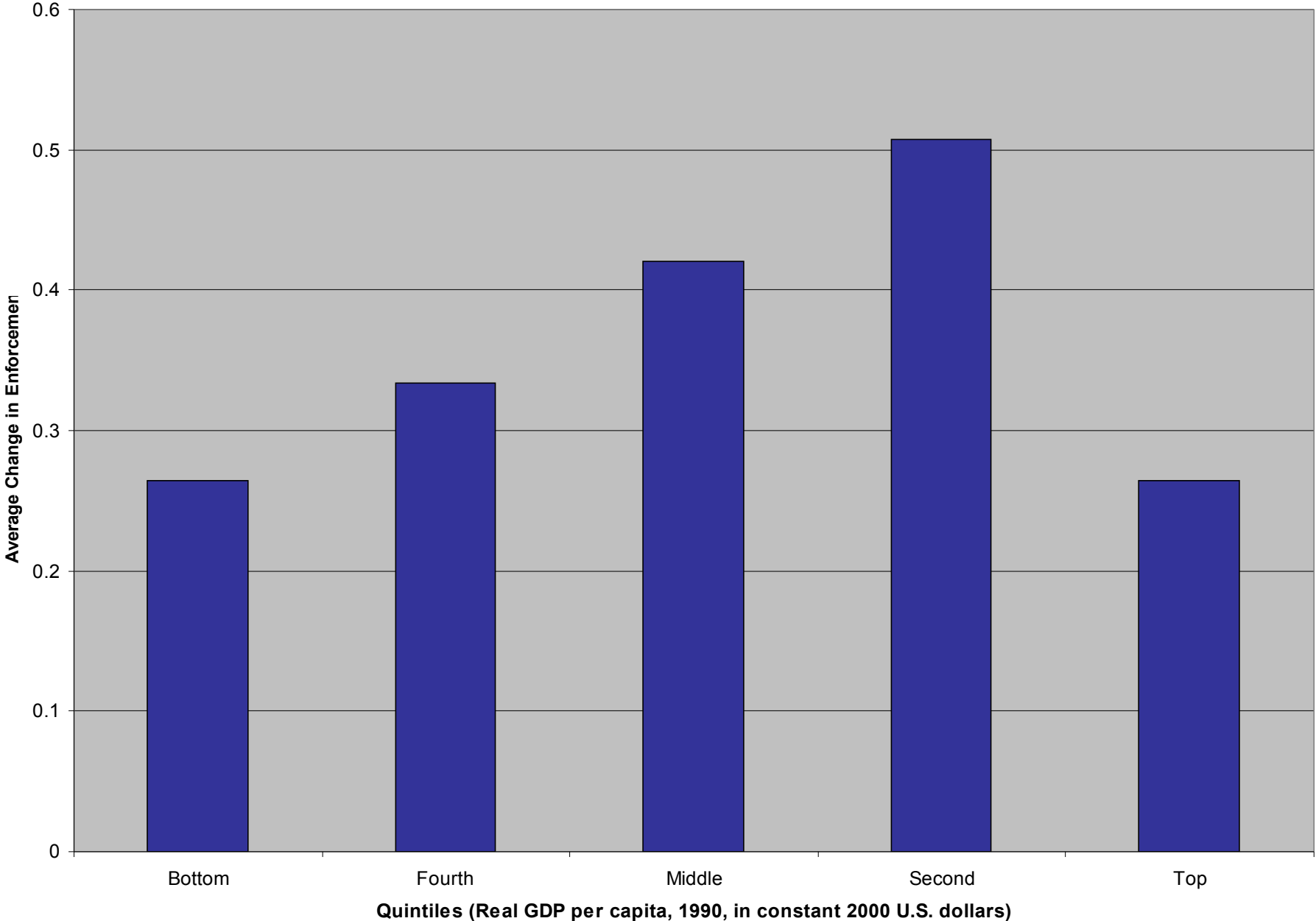**Figure 3. Increase in Enforcement Mechanisms**

Quintiles (Real GDP per capita, 1990, in constant 2000 U.S. dollars)

Figure 4. Increase in 'Restrictions' Score by Income Group
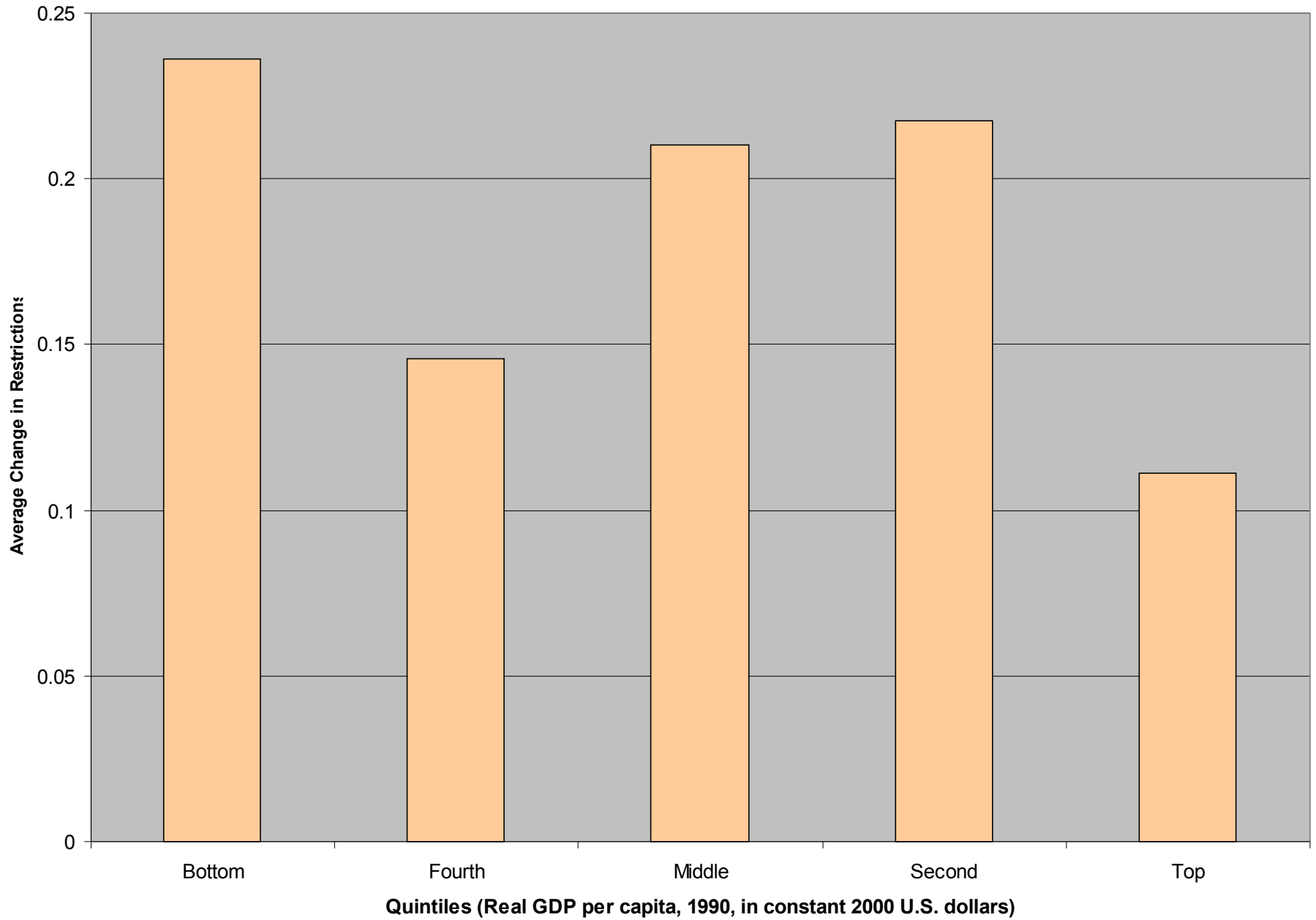
Figure 5. Increase in Membership in International Treaties by Income Group

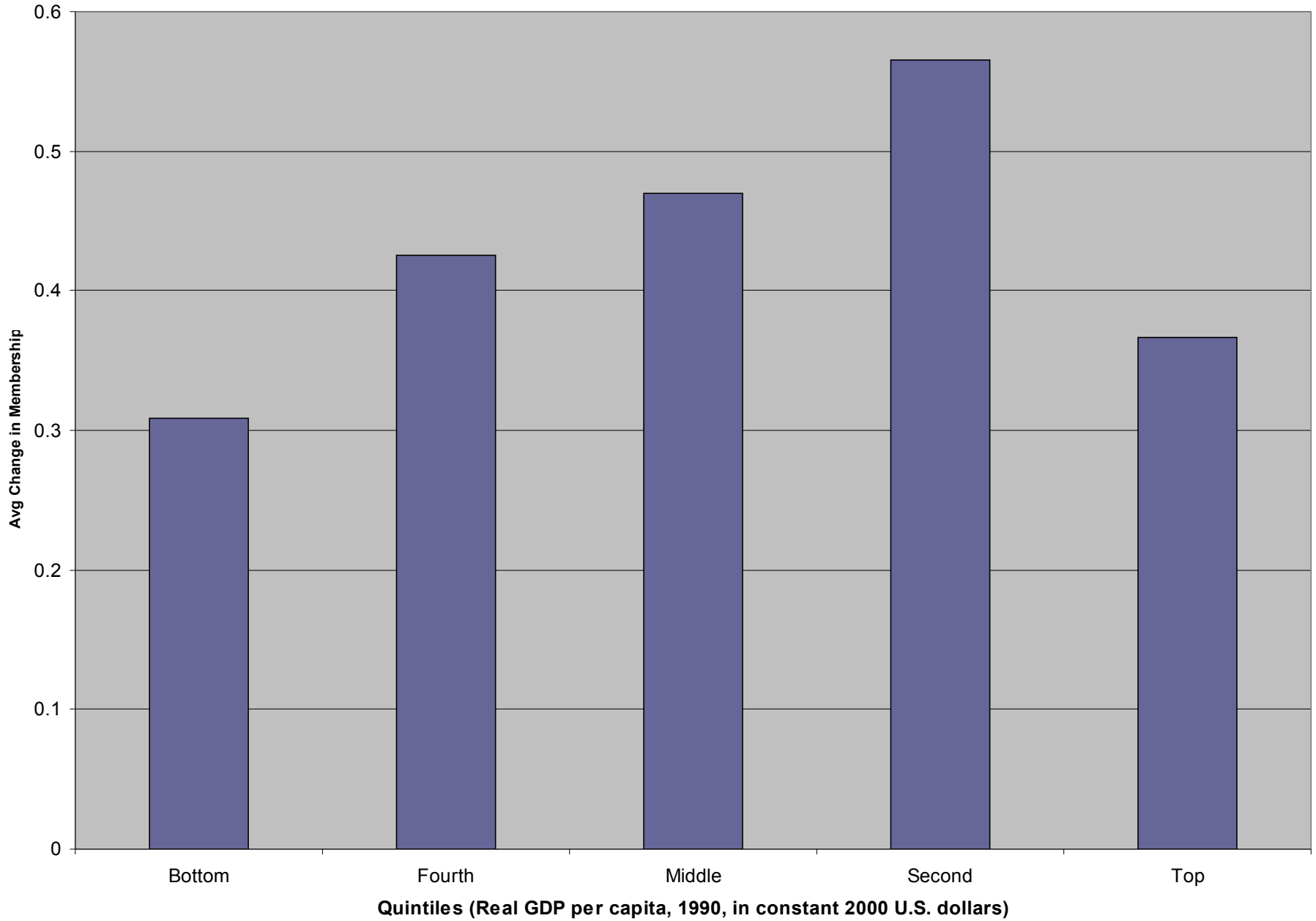Quintiles (Real GDP per capita, 1990, in constant 2000 U.S. dollars)

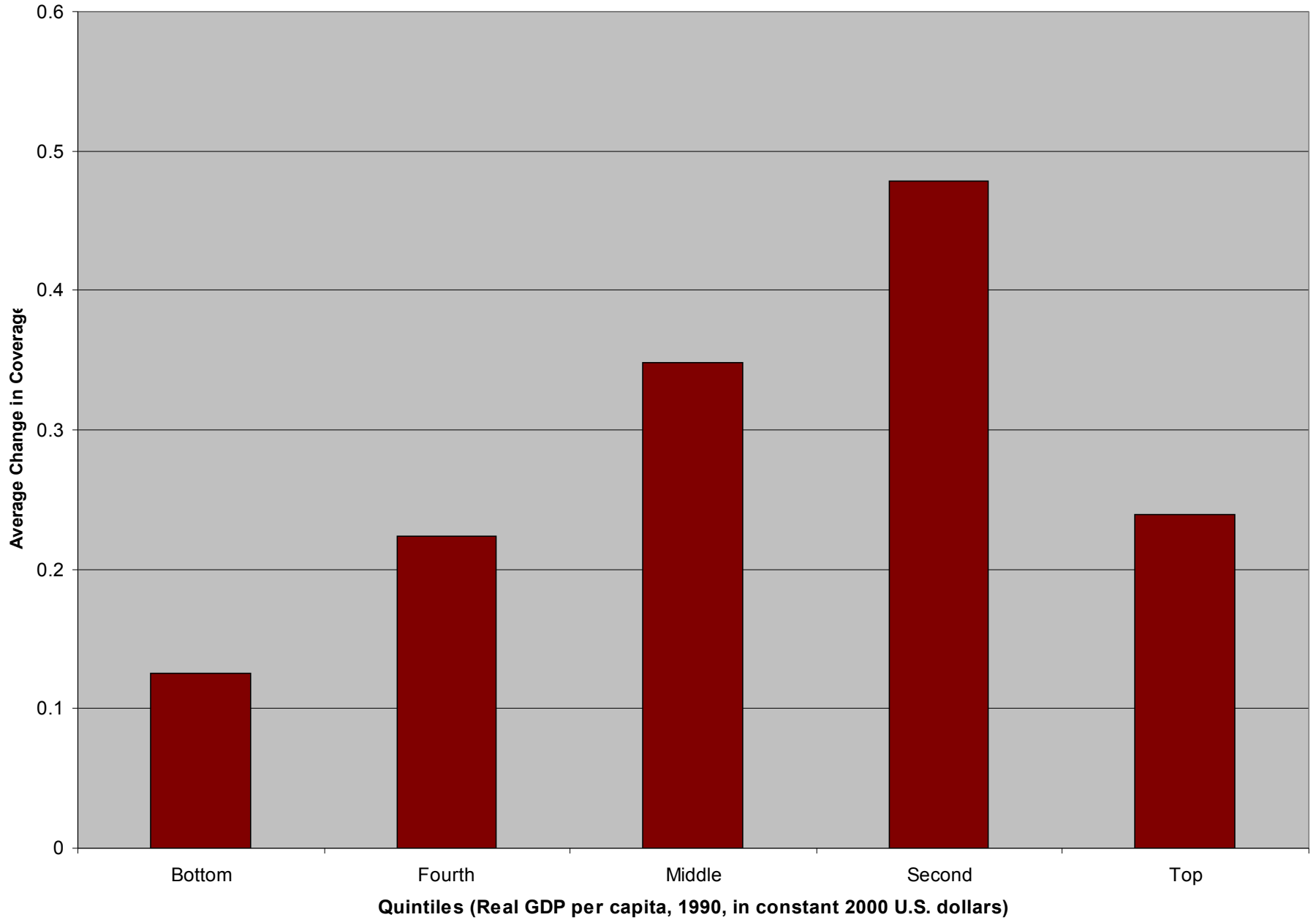**Figure 6. Increase in Coverage of Patentable Subject Matter by Income Group**

Figure 7. Composition of Change in Patent Strength 1990-2005, Bottom Quintile

%Chng Coverage
1%

%Chng Duration
6%

%Chng Enforcement
21%

%Chng Loss of Rights
19%
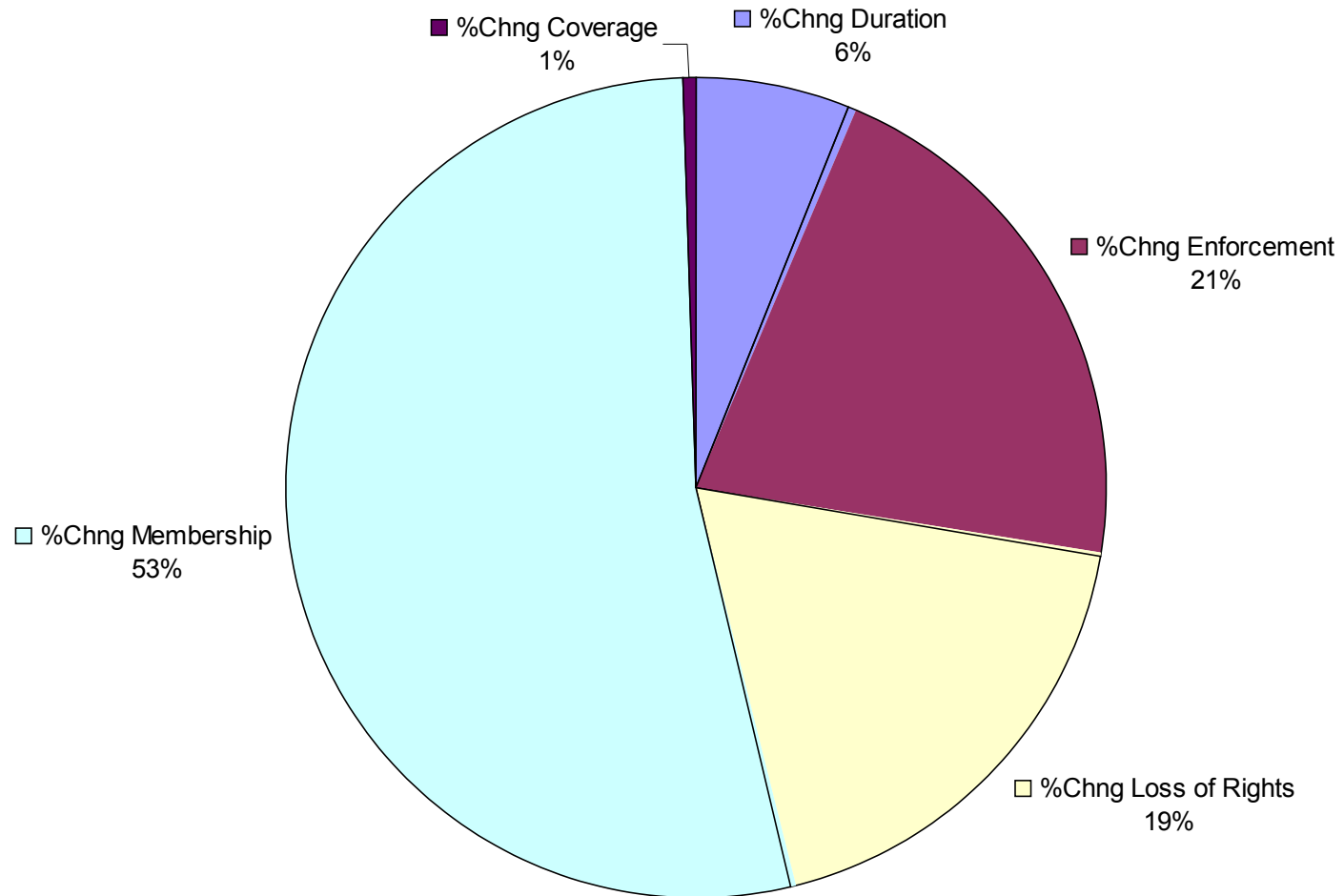
%Chng Membership
53%

☐ %Chng Duration ■ %Chng Enforcement ☐ %Chng Loss of Rights ☐ %Chng Membership ■ %Chng Coverage

Figure 8. Composition of Change in Patent Strength 1990-2005, Fourth Quintile

%Chng Duration
9%

%Chng Coverage
19%

%Chng Enforcement
20%

%Chng Loss of Rights
10%
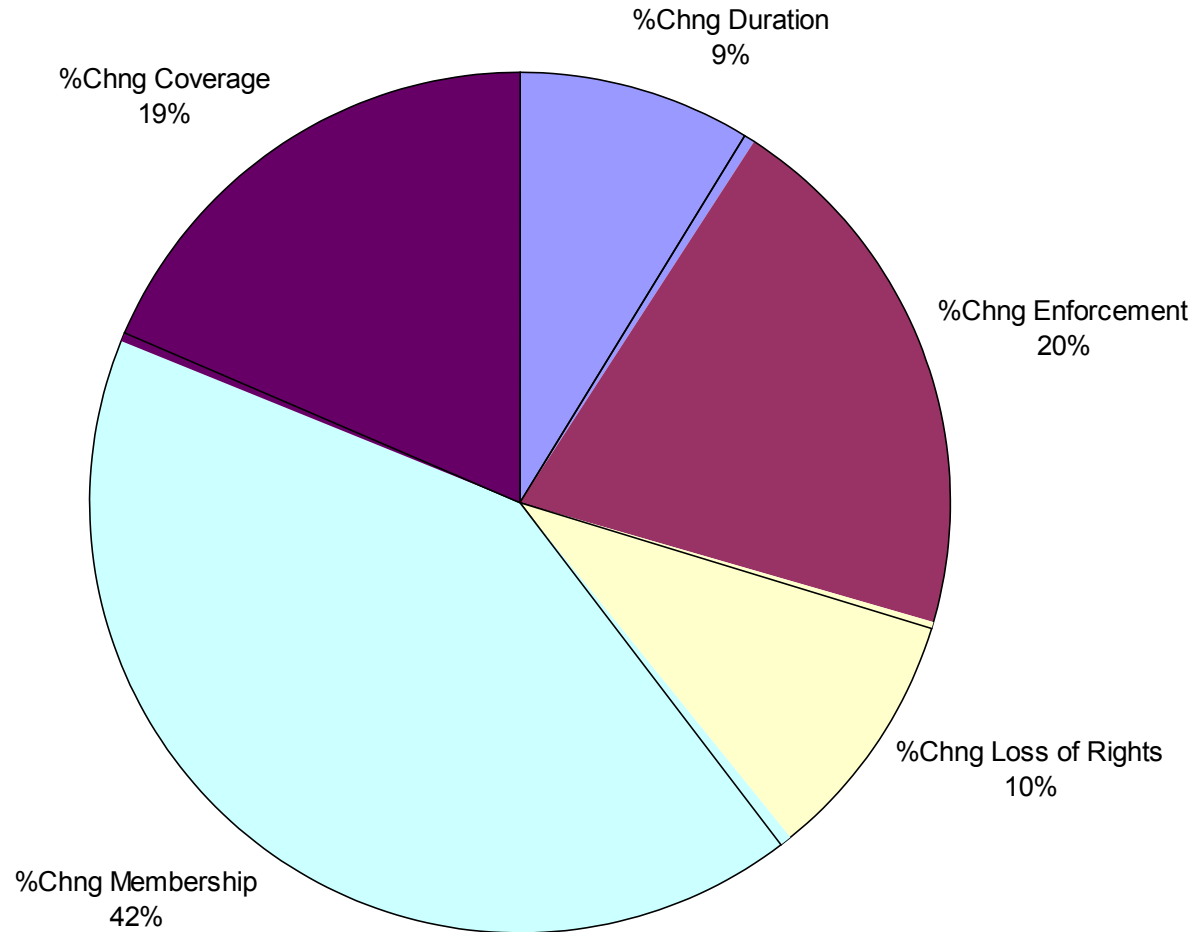
%Chng Membership
42%

☐ %Chng Duration ■ %Chng Enforcement ☐ %Chng Loss of Rights ☐ %Chng Membership ■ %Chng Coverage

Figure 9. Composition of Change in Patent Strength 1990 - 2005, Middle Quintile

%Chng Duration
13%

%Chng Coverage
20%

%Chng Enforcement
21%

%Chng Loss of Rights
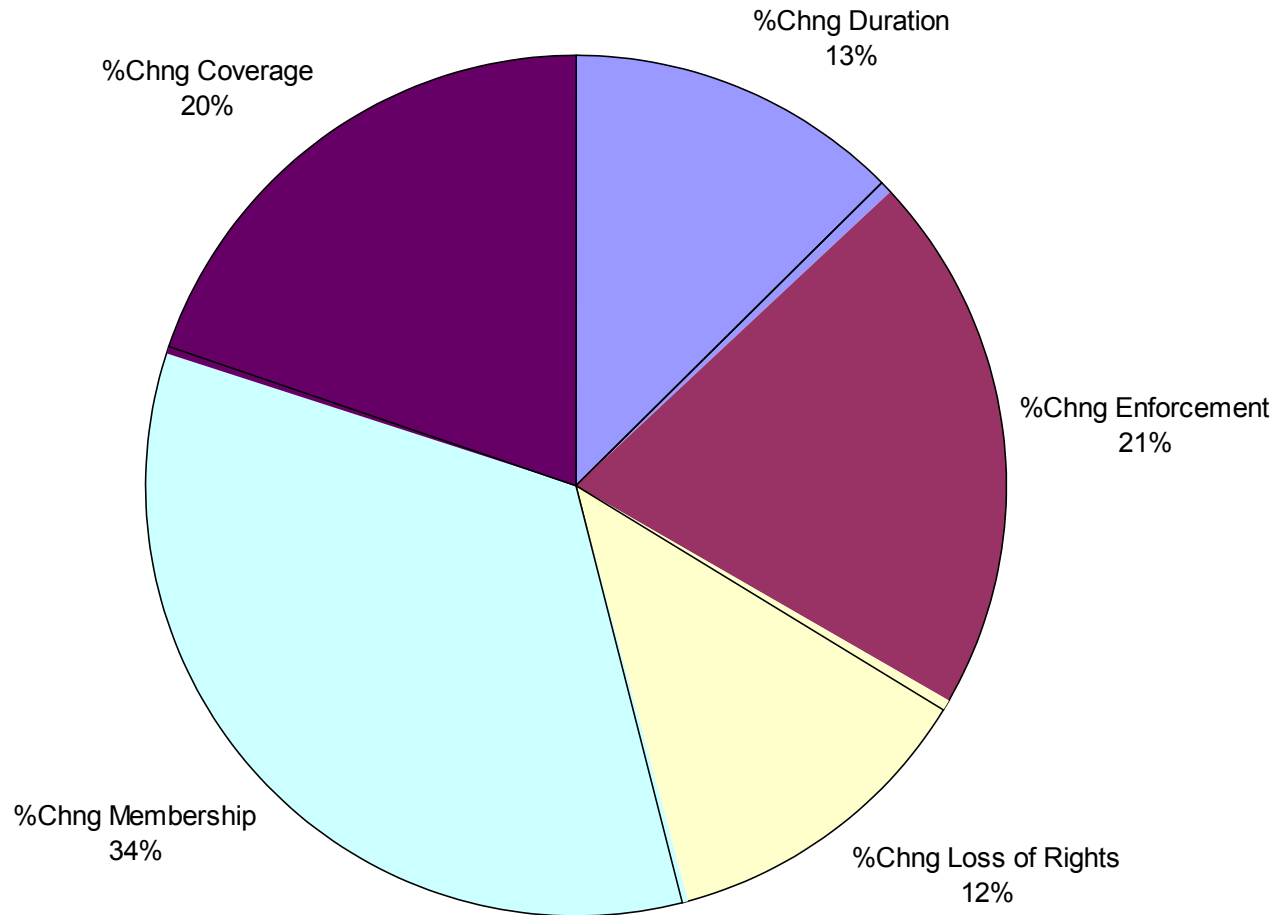12%

%Chng Membership
34%

■ %Chng Duration ■ %Chng Enforcement □ %Chng Loss of Rights □ %Chng Membership ■ %Chng Coverage

Figure 10. Composition of Change in Patent Strength 1990 - 2005, Second Quintile

%Chng Duration
8%

%Chng Coverage
27%

%Chng Enforcement
24%

%Chng Loss of Rights
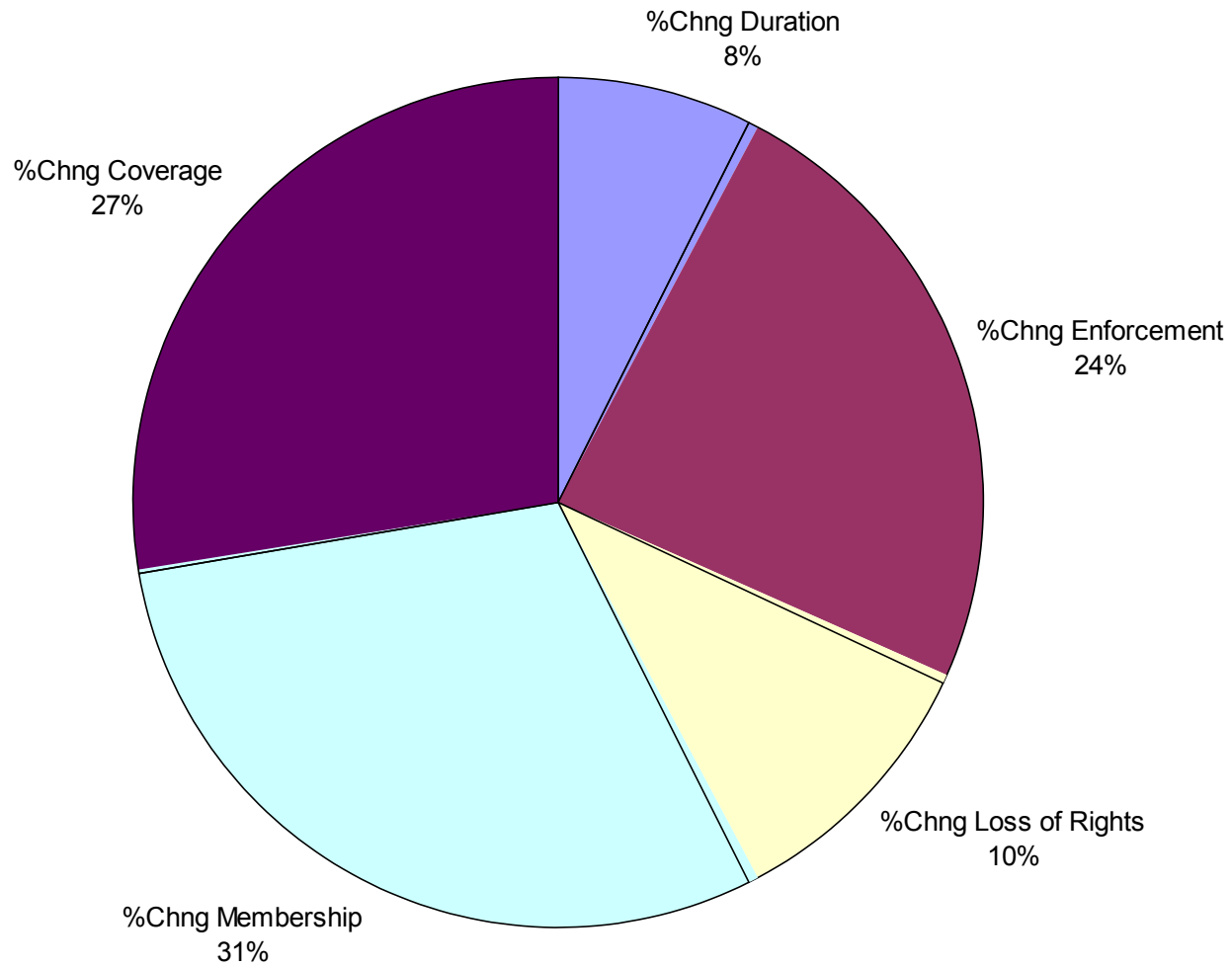10%

%Chng Membership
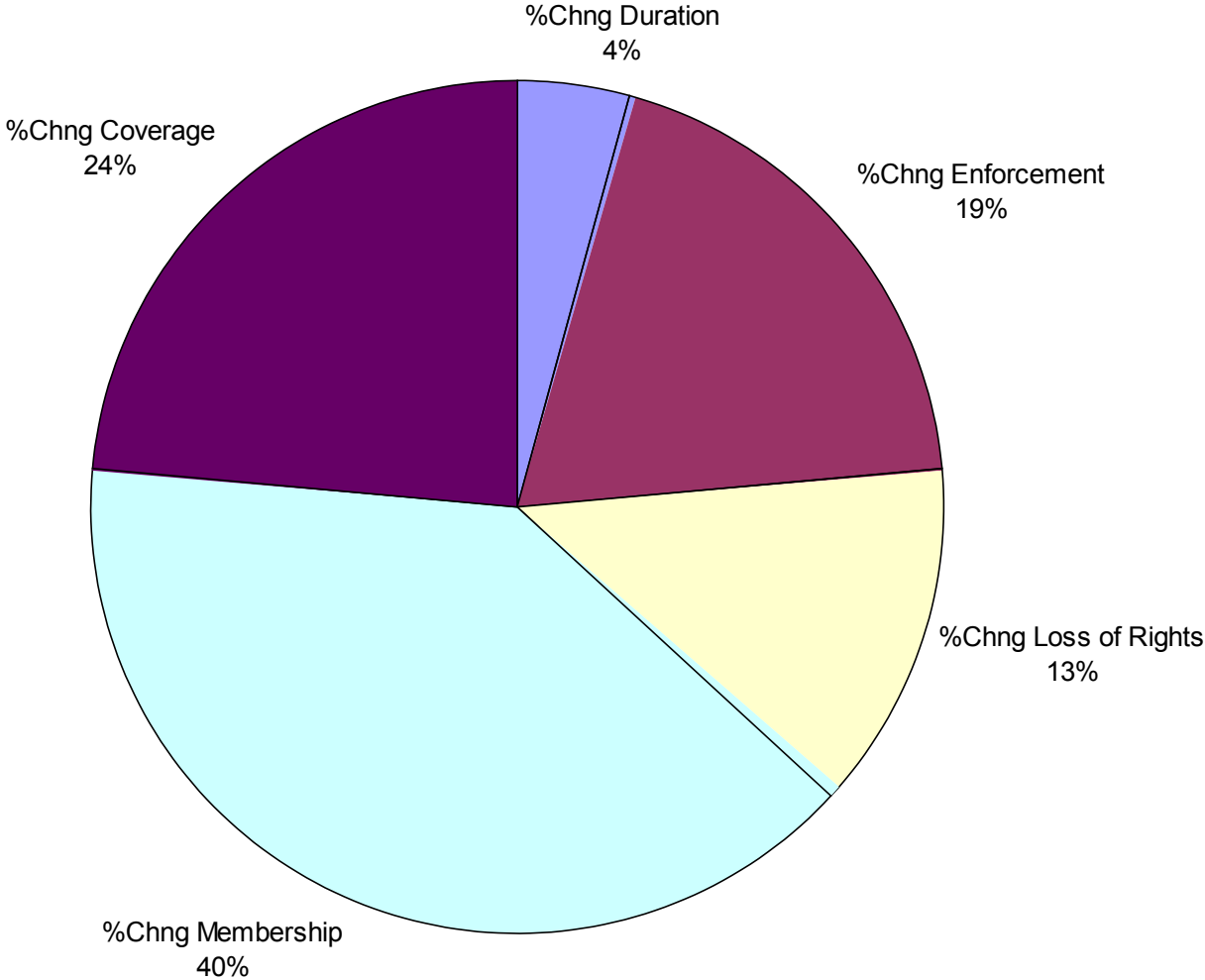31%

□ %Chng Duration ■ %Chng Enforcement □ %Chng Loss of Rights □ %Chng Membership ■ %Chng Coverage

Figure 11. Composition of Change in Patent Strength 1990 - 2005, Top Quintile

%Chng Duration
4%

%Chng Coverage
24%

%Chng Enforcement
19%

%Chng Loss of Rights
13%

%Chng Membership
40%

☐ %Chng Duration ☐ %Chng Enforcement ☐ %Chng Loss of Rights ☐ %Chng Membership ☐ %Chng Coverage

II. Patent Strength and Stages of Economic Development

- **Theoretical Literature:**
  - Grossman and Lai (2004) *AER*
    - Optimal Strength varies North vs. South
  - Eicher and Penalosa (2006) Univ. of Washington
    - Threshold Effects
  - Chen and Puttitanun (2005) *JDE*
    - Nonlinearities
- **Issues (positive & normative):**
  - Why developing economies protect IP less strongly, and should they have weaker protection?

Optimal Patent Protection?

- Let θ denote Index of Patent Rights
- Choose θ to Maximize Social Welfare (SW)
- Let $\theta^* = $ arg Max SW

"+"   "+"

- $\theta^* = \theta^*$(Income Level, Innovative Capacity, …)
- Are there local optima?
    - Beyond some critical level of income or innovative capacity, is a lower θ conducive?
    - Around that point, is increased income or innovative capacity associated with a lower (or higher) level of patent strength?

Determinants of Patent Strength

- Nonlinearities, Thresholds, Stage of Development
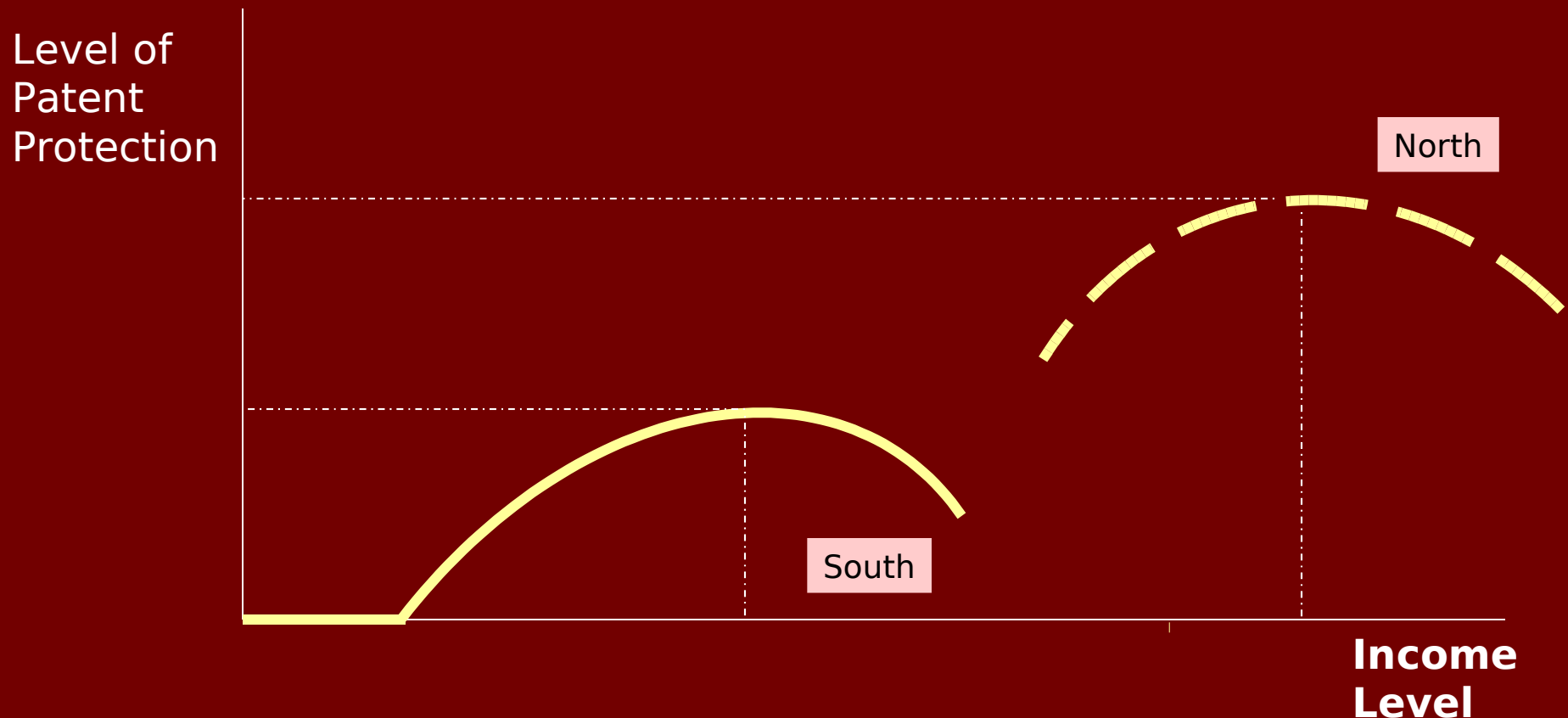
Determinants of Patent Strength

- Nonlinearities, Thresholds, Stage of Development

An Empirical Look

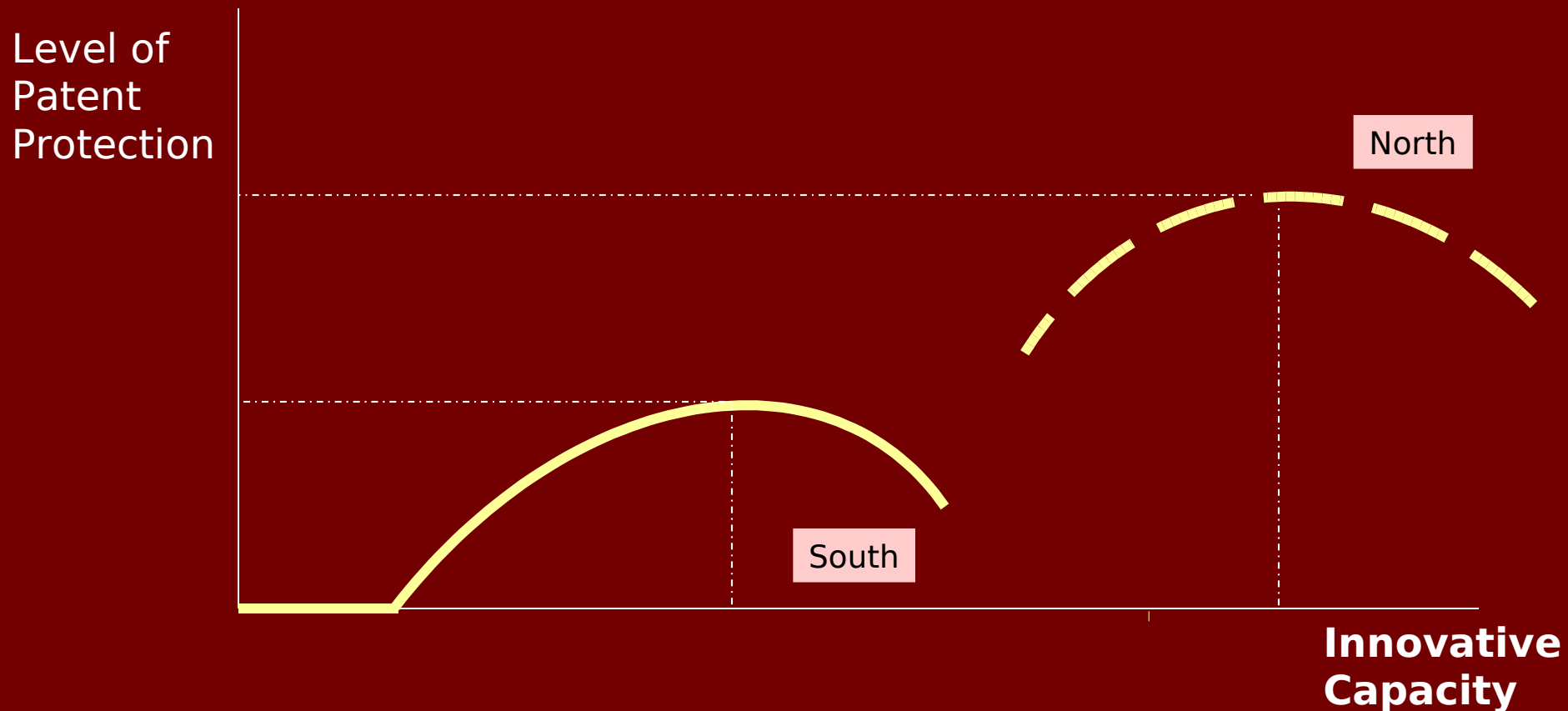- Patent Rights Index = f(Income Level, Income Level Squared, Innovative Capacity, Innovative Capacity Squared, . . .)

$$\ln(\text{Pat Index})_{it} = \alpha_0 + \alpha_1 \ln(\text{GDP per capita})_{it} + \alpha_2 \ln(\text{GDP per capita})_{it}^2$$

$$+ \alpha_3 \ln(\text{Resident Patents})_{it} + \alpha_4 \ln(\text{Resident Patents})_{it}^2$$

$$+ \alpha_5 \ln(\frac{R\&D}{GDP})_{it} + \alpha_6 \ln(\frac{R\&D}{GDP})_{it}^2 + \text{error}_{it},$$

$$\text{Critical GDP per capita} = \exp(\frac{\hat{\alpha}_1}{-2\hat{\alpha}_2})$$

$$\text{Critical Resident Patents} = \exp(\frac{\hat{\alpha}_3}{-2\hat{\alpha}_4})$$

$$\text{Critical} \frac{R\&D}{GDP} = \exp(\frac{\hat{\alpha}_5}{-2\hat{\alpha}_6})$$

Grouping of Countries

- **Absolute Ranking**
  - Sort all observations (122 countries, 1960 – 2005) in descending order of real GDP per capita*, and form three groups of data.
  - Same countries may be in different groups
- **Relative Ranking**
  - Sort observations (122 countries) in descending order of real GDP per capita in 1990*, and form three groups of countries
  - Countries per group are fixed

* in constant 2000 U.S. dollars

Sample Statistics: Ranges

- Absolute Ranking of Real GDP per capita

	Patent Rights Index	Real GDP per capita	Resident Patents	R&D/GDP
High Income	Min 0.92 Max 4.88	Min $4,047 Max $52,183	Min 0 Max 384,201	Min 0.1% Max 4.67%
Middle Income	Min 0.59 Max 4.54	Min $704 Max $3,981	Min 0 Max 93,172	Min 0.01% Max 2.77%
Low Income	Min 0.75 Max 3.76	Min $57 Max $699	Min 1 Max 10,011	Min 0.01% Max 1.25%

Sample Statistics: Ranges

- Relative Ranking of Real GDP per capita 1990

	Patent Rights Index	Real GDP per capita	Resident Patents	R&D/GDP
High Income	Min 1.26 Max 4.88	Min $2,251 Max $52,183	Min 0 Max 384,201	Min 0.22% Max 4.67%
Middle Income	Min 0.54 Max 4.54	Min $229 Max $16,006	Min 0 Max 121,942	Min 0.01% Max 3.97%
Low Income	Min 0.20 Max 4.18	Min $57 Max $1,526	Min 1 Max 93,172	Min 0.01% Max 1.34%

Panel Tobit: Absolute Ranked Samples

Dep Var: Pat Index	High Income	Middle Income	Low Income
Ln Real GDP p.c.	4.13***	-4.76**	-15.7***
Ln Real GDP p.c. Squared	-0.216***	0.320**	1.39***
Ln Resident Patents	0.148***	0.087	-0.372**
Ln Resident Patents Squared	-0.009***	-0.005	0.009
Ln R&D/GDP	0.139***	0.132*	1.04***
Ln R&D/GDP Squared	-0.041*	0.037*	0.14***
Year Effects	Included	Included	Included
Implied Critical Real GDP p.c.	$14,420	$1700	$288
Implied Critical Resident Patents	3,350	None	None
Implied Critical R&D/GDP	5.2%	None	None

***, **, and * indicate significance levels of 1%, 5%, and 10% respectively. Estimates of constant term omitted.

Panel Tobit: Relative Ranked Samples

Dep Var: Pat Index	High Income	Middle Income	Low Income
Ln Real GDP p.c.	4.10***	-0.652	2.31
Ln Real GDP p.c. Squared	-0.204***	0.043	-0.158
Ln Resident Patents	0.161***	0.082	-0.059
Ln Resident Patents Squared	-0.008***	-0.006	0.004
Ln R&D/GDP	0.132***	0.218***	0.001
Ln R&D/GDP Squared	0.001	0.048***	-0.007
Year Effects	Included	Included	Included
Implied Critical Real GDP p.c.	$22,750	None	$436
Implied Critical Resident Patents	23,600	None	None
Implied Critical R&D/GDP	None	None	None

***, **, and * indicate significance levels of 1%, 5%, and 10% respectively. Estimates of constant term omitted.

Summary:

- **Economic Development and Patent Strength:**
  - Some Evidence of Nonlinearity
    - Inverse-U for High Income Group
    - Possible U-shape for Low & Middle Income Groups
- **R&D and Patent Strength:**
  - Positive Association for high and middle income groups (and possibly for low income group)
- **Resident Patenting and Patent Strength:**
  - Nonlinear (inverted-U) for High Income Group
  - Possible Negative Association for Low Income Group
- **Future: Examine Threshold Effects more**
  - Especially for Low Income Group

Appendix:

- For comparisons, the next two tables repeat the regression analysis with Panel Fixed Effects
  - i.e., no constraint on range of values for dependent variable.

Panel Fixed Effects: Absolute Ranked Samples

Dep Var: Pat Index	High Income	Middle Income	Low Income
Ln Real GDP p.c.	5.79***	-5.34	-2.38
Ln Real GDP p.c. Squared	-0.305***	0.377	0.230
Ln Resident Patents	0.154***	-0.290	0.132
Ln Resident Patents Squared	-0.011***	0.016	-0.018
Ln R&D/GDP	0.240***	0.053	1.23
Ln R&D/GDP Squared	-0.060*	-0.015	0.76*
Year Effects	Included	Included	Included
Implied Critical Real GDP p.c.	$13,600	None	None
Implied Critical Resident Patents	1,300	None	None
Implied Critical R&D/GDP	7.3%	None	None

***, **, and * indicate significance levels of 1%, 5%, and 10% respectively. Estimates of constant term omitted.

Panel Fixed Effects: Relative Ranked Samples

Dep Var: Pat Index	High Income	Middle Income	Low Income
Ln Real GDP p.c.	4.84***	-0.682	6.07***
Ln Real GDP p.c. Squared	-0.236***	0.045	-0.499***
Ln Resident Patents	0.131***	-0.097	-0.024
Ln Resident Patents Squared	-0.007***	0.003	0.015
Ln R&D/GDP	0.186***	-0.012	0.032
Ln R&D/GDP Squared	0.021	-0.062	0.357
Year Effects	Included	Included	Included
Implied Critical Real GDP p.c.	$28,600	None	$436
Implied Critical Resident Patents	15,930	None	None
Implied Critical R&D/GDP	None	None	None

***, **, and * indicate significance levels of 1%, 5%, and 10% respectively. Estimates of constant term omitted.