



Technology Diffusion and Income Inequality:

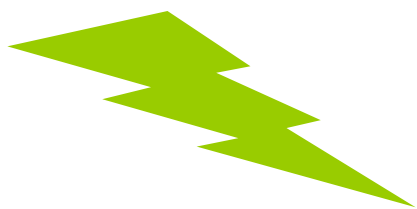
how augmented Kuznets hypothesis
could explain ICT diffusion?

Miguel Torres Preto

Motivation: Technology and Inequality

- This study aims at making a contribution towards widening the understanding of the relationships between income inequality and technology diffusion
- Previous research traditionally conceptualized as a one-way relationship and from the production side: new technologies contribute to increase economic inequality
 - (Schmitt 1995, Krussell 1997, Bound and Johnson 1992, Card and Lemieux 2000, Acemoglu and Pischke 2000, Vindigni 2002)
- Recent increase in economic inequality in most advanced countries has been attributed to the diffusion of ICTs, raising the skill premium for computer literates
 - (Acemoglu 2002)
- The issue of how inequality influences the adoption of technology is seldom studied and there is a clear lack of models and empirical studies to illustrate it
- Exceptions include a few studies on the “digital divide” issue
 - (Castells 1998, Hargittai 1999, Norris 2001, Sachs 2002)

Research Hypothesis



- **Inequality negatively influences the demand conditions for consumption technologies considering ICTs as consumption goods that end-users acquire and use**

- **ICTs**

- Computers designed to be used by a single individual
- People with Internet access to the worldwide network
- Users of portable telephones subscribing service providing access to the public switched telephone network

- **Time period:** 1981-2002

- **Sample:** 25 OECD countries

- Australia Austria Belgium Canada Denmark
- Finland France Germany Greece Hungary
- Ireland Italy Japan Korea Luxembourg
- Netherlands New Zeal. Norway Poland Portugal
- Slovakia Spain Sweden UK USA

Models and Methodology

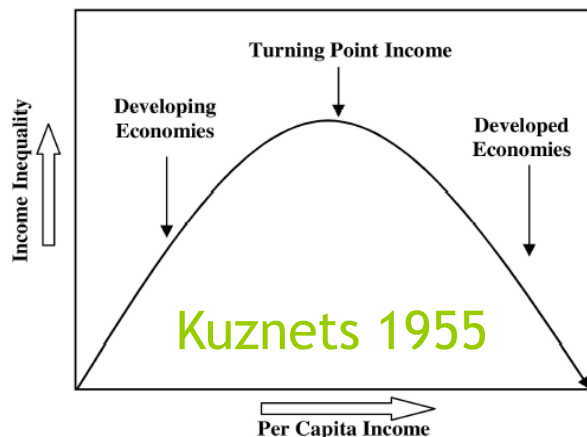
Data source:
World Bank WDI 2003

- Diffusion Models

$$\text{dif } \tau (c, t) = X(c, t) \cdot B\tau + \mu\tau c$$

Endogeneity between inequality and income

Kuznets Hypothesis



- Kuznets Models

$$I_{it} = a + by_{it} + cy_{it}^2 + dy_{it}^3 + u_{it}$$

dif τ - rate of adoption

c - country

t - year

τ - technology

Personal computers
Internet users
Mobile phones

X - explanatory variables

inequality

income GDP per capita (log)

secondary school

tertiary school

services sector weight

foreign direct investment

telephone main lines

I - inequality

y - income GDP per capita (log)

Inequality Database

- Construction of a database of income inequality consistent over time and comparable across countries
 - Data Source: STAN (STructural ANalysis)
 - Sample: 25 OECD countries
 - Time period: 1981-2002
 - **Theil index (Conceição and Galbraith 2001)**
 - Wage - labor costs (include supplements)
 - Labor - number engaged (total employment)

$$T = \lim_{\alpha \rightarrow 1} \left[\frac{1}{\alpha^2 - \alpha} \frac{1}{N} \sum_{i=1}^N \left(\frac{y_i}{\bar{y}} \right)^\alpha - 1 \right] = \frac{1}{N} \sum_{i=1}^N \frac{y_i}{\bar{y}} \cdot \ln \left(\frac{y_i}{\bar{y}} \right)$$

N - no. of people in the population

y_i - income of the i^{th} person

\hat{y} - average income



Results: Income and Inequality

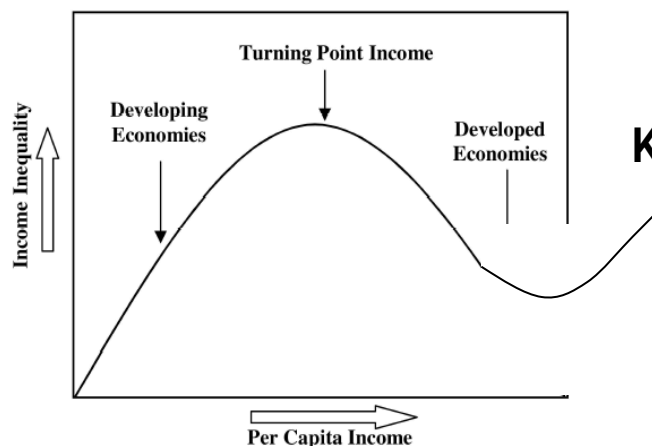
Specification problem of ICT diffusion model

Endogenous relationship between inequality and income

Identifying this relationship the endogeneity problem is overcome

Inequality as a cubic polynomial of income GDP per capita calculated for 25 OECD countries for 1970-2000

Augmented Kuznets curve emerges in most of the models



Augmented
Kuznets Hypothesis



Results: ICT Diffusion and Inequality

Panel Data Regression Results for PCs Diffusion Model (Fixed Effects)

Proxy of Inequality	Education			Services		FDI		Phone	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
a	-25654.430** (12381.6889)	-21939.490** (11880.7145)	-19013.980 (11791.2590)	-22522.020* (12457.3636)	-21539.600* (11742.2536)	-22991.120* (11758.1836)	-22001.512** (11774.8360)	-27112.621** (11467.3601)	-25369.861** (11020.1444)
y_{it} [ln(GDP)]	9424.964** (4037.0423)	8288.863** (3861.8923)	7402.672* (3832.5167)	8233.851** (4045.5180)	8148.995** (3816.0600)	8390.908** (3826.7790)	8262.439** (3637.8140)	10003.774*** (3739.1991)	9556.558*** (3594.1737)
y_{it}^2 [ln(GDP) ²]	-1194.383*** (436.5014)	-1081.725*** (416.2022)	-986.712** (413.1017)	-1039.820** (435.4298)	-1035.837** (410.9072)	-1051.280** (412.8914)	-1041.657*** (392.5667)	-1236.398*** (403.7681)	-1189.815*** (388.1787)
y_{it}^3 [ln(GDP) ³]	51.065*** (15.6516)	47.304*** (14.8703)	43.709*** (14.7638)	44.006*** (15.5411)	43.516*** (14.6681)	44.121*** (14.7750)	43.484*** (14.0485)	50.645*** (14.4456)	48.739*** (13.8896)
SecEduc [Secondary School Enrolment]		1.281***	0.993***	1.355***	0.530**	1.343***	0.665***	1.454***	0.807***

Level of inequality important for ICT diffusion

Hypothesis: inequality hinders ICT diffusion is rejected

Phone [Telephone mainlines]								0.405*** (0.1040)	0.317*** (0.1012)
F-test	314.63***	293.23***	232.31***	148.82***	145.55***	157.13***	152.10***	144.99***	139.39***
R ²	0.38	0.39	0.40	0.43	0.49	0.42	0.49	0.47	0.53
Observations	347	335	330	268	265	264	262	264	262

Note: Standard errors are in brackets.

Estimates significant below the 1% level are in bold.

Results: ICT Diffusion and Inequality

Panel Data Regression Results for PCs Diffusion Model (Fixed Effects)

	Education			Services		FDI		Phone	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SecEduc [Secondary School Enrolment]	(15.6516)	(14.8703)	(14.7638)	(15.5411)	(14.6681)	(14.7750)	(14.0485)	(14.4456)	(13.8896)
		1.281***	0.993***	1.355***	0.530**	1.343***	0.665***	1.454***	0.807***
		(0.2123)	(0.2499)	(0.2212)	(0.2535)	(0.2025)	(0.2354)	(0.1987)	(0.2355)
TertEduc [Tertiary School Enrolment]			1.021**		3.112***		2.615***		2.393***
			(0.4222)		(0.5358)		(0.5027)		(0.4984)
Serv [Services Value Added %GDP]				3.066***	1.001	1.682*	0.005	-2.208*	-2.889**
				(0.9144)	(0.9343)	(0.8726)	(0.8867)	(1.3106)	(1.2691)
FDI [Foreign Direct Investment]						9.042***	8.218***	8.569***	7.934***
						(1.5547)	(1.4800)	(1.515)	(1.4553)
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Education is relevant in most of the models (specially for PCs)

FDI is a positive determinant of the ICT diffusion

Conclusions

- Empirical evidence of the augmented Kuznets hypothesis
- Existence of inequalities does not hinder the diffusion of technologies at least for the countries considered
- Our proxy of inequality (cubic polynomial of income GDP) has a positive correlation with the ICT adoption rate coefficients
- “New commodities diffuse from the rich to the masses”
 - (Galbraith 1998)
- Relevance of the variables concerning human capital and foreign direct investment as drivers of ICT diffusion

Further Work

- Introduction of new independent and controlling variables
 - Monopoly power
 - Public/private telecommunications providers
 - Hedonic model of prices of technologies
 - Relationships among technologies
- Widen sample
 - Developing countries
- Cases studies
 - Unit of analysis: region



INSTITUTO SUPERIOR TÉCNICO
Universidade Técnica de Lisboa



Center for Innovation, Technology and Policy Research
Centro de Estudos em Inovação, Tecnologia e Políticas de Desenvolvimento

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