Trade liberalisation, product variety and growth

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Idea and contents

(Transition) literature: (trade) liberalisation is good for growth. What could be the channel?

No canonical model of openness and growth, nor on the impact of trade liberalisation on income and growth.

Here: follow variety-based, (semi-)endogeneous growth literature to link input variety to technology and growth. Answers to two questions might then provide insight into a potential link between reform and growth:

(1) Is input variety a measure for state of technology?

(2) Does trade liberalisation influence input variety?

Questions are not answered within one consistent model, rather based on

Product Variety and Technical Change (with Vitalija Gaucaite Wittich). *Journal of Development Economics 88*, 2, March 2009.

Trade Liberalisation and Import Margins. *Emerging Markets Finance & Trade 46*, 3, May–June 2010.

First question:
Is input variety a measure of technology?

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Define the state of technology as the range of specialised production processes (Smithian division of labour)

Propose the variety of capital goods available for production as a direct measure of state of technology (Romer, 1990; Jones, 2002, ch. 6)

Within a basic growth model, derive a *conditional technological convergence hypothesis* on the change of capital goods variety

Test the hypothesis with trade data to proxy available capital goods variety

Framework: A basic semi-endogenous growth model (Jones, 2002, ch. 6)

Production uses labour and a variety h of intermediate capital goods, x_j

$$Y(t) = L(t)^{1-\alpha} \int_0^{h(t)} x_j^{\alpha}(t)dj \tag{1}$$

h is country-specific technology. With $x_j = x$ and costless transformation of raw capital K into capital goods

$$Y(t) = K(t)^{\alpha}(h(t)L(t))^{1-\alpha} \tag{2}$$

Labour grows at n. Physical capital accumulation is standard,

$$\dot{K}(t) = sY(t) - d \cdot K(t) \tag{3}$$

s is the rate of investment and d the rate of depreciation of capital

Change of technology

Change of technology: deepening the division of labour by increasing capital goods variety

Worldwide technology frontier $H(t)$ expands at constant g (innovation). New capital goods are diffused across and within countries via whichever channel.

Country-specific change of technology (adoption) requires the workforce to learn how to use new capital good innovations

$$\frac{\dot{h}(t)}{h(t)} = \mu e^{\psi u} B(t)^{-\gamma} \qquad (4)$$

$B = h/H$: distance to the technological frontier
u: length of schooling
ψ/γ : returns to schooling, $0 < \gamma \leq 1$,
μ: institutional influences on the learning process.

Learning – and thus technical progress – is easier,

- the higher the distance to the technological frontier
- the better educated the workforce

On and around the steady state

The growth rate of h is constant in the steady state, and equal to g, thus

$$B^* = \left(\frac{\mu}{g} e^{\psi u} \right)^{\frac{1}{\gamma}} \tag{5}$$

Log-linearisation of (4) around the steady state of B:

$$\delta_{h(t)} \equiv \frac{\dot{h}(t)}{h(t)} \approx \mu e^{\psi u} \left[e^{-\gamma \ln B^*} - \gamma e^{-\gamma \ln B^*} \left(\ln B(t) - \ln B^* \right) \right] \tag{6}$$

$$\delta_{B(t)} = \frac{d \ln B(t)}{dt} \approx \gamma g \ln B^* - \gamma g \ln B(t) \tag{7}$$

(7) is a linear differential equation in $\ln B$ with the solution

$$\ln h(t) - \ln h_0 = gt + \left(1 - e^{-\gamma g t}\right)\left(\ln B^* - \ln B_0\right) \tag{8}$$

A testable hypothesis on conditional technological convergence

$$\ln h(t) - \ln h_0 = gt + \left(1 - e^{-\gamma g t}\right)\left(\ln B^* - \ln B_0\right) \qquad (8)$$

$0 < \gamma \leq 1$, g is "small", our time horizon is "short": approximate $e^{-\gamma g t}$ by $1-\gamma g t$

With B^* in (5), (8) transforms into a testable hypothesis,

$$(\ln h(t) - \ln h_0)/t = (g - g \ln g + \gamma g \ln H_0) - \gamma g \ln h_0 + g\psi u + g \ln \mu \qquad (9)$$

- Interpreting (9) in discrete time, $(\ln h_t - \ln h_0)/t$ is an average yearly rate of change of capital goods variety available for production as a measure of technology
- $(\ln h_t - \ln h_0)/t$ depends negatively on initial variety and positively on formal education parameters, and on other influences on the productivity of the learning process.

Trade-based measurement of variety

UN ComTrade data for 46 OECD and transition countries' exports to ROW and imports from 55 partner countries between 1992 and 2004

Classification: SITC Rev. 3, 5-digit level, covering 3,114 *items*

Classification by Broad Economic Categories (BEC) allows grouping SITC items into basic SNA categories: *primary*, *intermediate, capital*, and *consumer goods*

Let export proxy production.

Let product differentiation also reflect country of origin.

Then, *available product variety*: the number of imported items times the number of their countries of origin plus the number of exported items

- Maximum count of available product variety over all items is 174,384
- With an average of 40.2 countries reporting per year, our product variety measures require manipulation of some 90 million data points

Variety, trade and technology: Identification

Interdependence between technology, trade, and income calls for simultaneous equations approach

Short-cut: consumption goods variety is a pure trade measure, does not influence income via a technology channel

Define the potentially technology-relevant variety measure as

the product variety of capital goods relative to the product variety of consumer goods, i.e. $CGV_{jt} = VarCap_{jt} / VarCon_{jt}$,

Identification by using the ratio of capital goods variety to that of consumer goods as a potential measure of technology involves two further assumptions:

- trade restrictions and demand are assumed to affect the variety of all traded goods identically
- the BEC categorisation correctly identifies goods

Data for testing conditional technological convergence

Dependent: $(\log CGV_{j,t+T} - \log CGV_{jt})/T$

Explanatory variables directly from (9):

- Log of initial variety (-)
- Years of schooling (u), assuming constant returns to schooling (+)
  - Additional institutional regressors (μ: sensitivity)

Control variables:

- Change in investment-consumption ratio, to control for specific demand effects across BEC categories (+)
- Trade liberalisation dummy, to control for specific trade liberalisation effects across BEC categories (?)
- Small size dummy (interacted with schooling), to control for size effects of technology adoption (-)
- Banking reform dummy (interacted with initial variety) to control for financial liberalisation effects on speed of technology adoption (Aghion et al., 2005, -)
  - Trade liberalisation and banking reform are dummy variables indicating whether or not a country has within a certain policy field made the step towards a certain level on some scale within a given period (EBRD)

Product variety growth regressions

	(1)	(2)	(3)
	Capital goods	Intermediate goods	Primary goods
Dependent variable:	$(\log CGV_{j,t+T} - \log CGV_{jt})/T$	$(\log IGV_{j,t+T} - \log IGV_{jt})/T$	$(\log PGV_{j,t+T} - \log PGV_{jt})/T$
Explanatory variables:			
Initial variety, $\log CGV_{jt}$	–0.024*** (–2.78)		
$\log IGV_{jt}$		–0.043*** (–4.09)	
$\log PGV_{jt}$			–0.025*** (–3.21)
Years of schooling, $schooly\_25_{j,tT}$	0.0014** (2.18)	0.0000052 (0.01)	–0.00054 (–0.53)
Trade liberalisation, $FT\_4plus_{j,tT}$	0.0073** (2.29)	0.0061* (1.73)	–0.0074 (1.41)
Investment-consumption ratio change, $inv\_con_{j,t+T} - inv\_con_{jt}$	0.064*** (4.00)	0.046** (2.50)	0.0073 (0.25)
Size, $GDP1 \times schooly\_25_{j,tT}$	–0.0012*** (–2.90)	–0.0023*** (–4.12)	–0.0020** (–2.33)
Banking reform, $BANK\_2plus_{j,tT} \times \log CGV_{jt}$	–0.070*** (–5.92)		
$BANK\_2plus_{j,tT} \times \log IGV_{jt}$		0.050*** (4.88)	
$BANK\_2plus_{j,tT} \times \log PGV_{jt}$			–0.0078* (–1.91)
Observations (1993–98, 1999–2004)	64 (25, 39)	64 (25, 39)	64 (25, 39)
Correlation between subperiod residuals	–0.19	0.10	–0.28
Adj. *R*-squared (1993–98, 1999–2004)	0.48, 0.61	0.50, 0.49	–0.41, 0.25

Notes: *t*-stats in parentheses. * (**, ***): significance at 10, (5, 1) per cent. Instruments: one year lagged initial relative product varieties. Interval dummies not reported.

Results

Schooling has significant effect in CGV, not in IGV or PGV estimations: one more year of schooling *cet. par.* causes some seventh percentage point increase in the yearly average growth rate of available CGV

In CGV regressions:

- conditional technological convergence among OECD and transition countries
- speed of convergence corresponds to that of per capita income
- Banking reforms exert a significant – and positive – effect on speed of convergence

Evidence: trade-based count measures of available CGV indeed behave "as if" representing technology, while measures of IGV or PGV do not

Sensitivity

Results are robust to:

- Sample composition (small country sample)
- Alternative small country size definitions
- Definition of intermediate goods
- Measurement of schooling
  - Length of school of labour-force-aged population (older than 15 or 25, all or female)
  - Share of labour-force-aged population with secondary education (all or female)
- Alternative policy reforms in transition
- Additional regressors
  - *population density,* share of *urban population*, mid-period logs of the sum of residents' and non-residents' *patent applications* and the sum of residents' and non-residents' *patent applications per employee*

Second question:
Does trade liberalisation influence input variety?

Second question: Does trade liberalisation influence input variety?

Trade policy has well documented effects on trade volumes, effects on the margins of trade (import variety *versus* intensity) are ignored, with few exceptions.

Here: assess the impact of recent CEEC trade liberalisation on imports, in particular decompose the impact on the two *margins of trade,*

- the set of imported goods (import variety)
- volumes per imported good (import intensity)
  - across different categories of (intermediate, capital and consumer) goods
  - within a gravity framework using highly disaggregated trade data

Background

- Frensch and Gaucaite Wittich (2009): a trade-based measure of the variety of capital (relative to consumer) goods behaves 'as if' it represented technology
- Also, Amiti and Konings (2007) suggest a link from higher import variety of intermediate inputs to productivity gains at the firm level.

Stronger trade reform effects on the variety of inputs (intermediate or capital goods) than for consumer goods indicate a *cet. par.* channel for the link between reforms and available input variety, and thus between reforms and growth.

Data issues: Variety and trade liberalisation

Trade-based variety measurement follows Frensch and Gaucaite Wittich (2009)

(Institutional) trade liberalisation: EBRD foreign trade and payments liberalisation index

Info on trade and payments liberalisation that applies equally to all goods categories

This index equals 4.33 for OECD economies, in line with construction.

EBRD index is ordered qualitative: consider *full* liberalisation, i.e., define *TradeLib* as 1 if the index equals 4.33, and 0 otherwise

Half of 1992–2004 *TradeLib* observations for ex-transition countries take the value of one.

A gravity framework

$$\log IMPORTS_{j,t} = \beta_{0,1} + \beta_{1,1} \log GDP\_Im_{j,t} + \beta_{2,1} TradeLib_{j,t} + c_{j,1} + k_{t,1} + \varepsilon_{j,t,1}, \quad (10)$$

for total imports,

$$\log Var_{c,t} = \beta_{0,2} + \beta_{1,2} \log GDP\_Im_{c,t} + \beta_{2,2} TradeLib_{c,t} + c_{j,2} + k_{t,2} + \varepsilon_{c,t,2}, \quad (11)$$

for import variety, and

$$\log Int_{c,t} = \beta_{0,3} + \beta_{1,3} \log GDP\_Im_{c,t} + \beta_{2,3} TradeLib_{c,t} + c_{j,3} + k_{t,3} + \varepsilon_{c,t,3}, \quad (12)$$

for import intensity.

Estimations include country (c_j) and period (k_t) fixed effects

- to control for time-invariant country-specific as well as country-invariant time-specific omitted variables (including trade barriers, multilateral trade resistance)
- to control for each year's data using a different numéraire since GDP and trade values are in current dollars (Baldwin and Taglioni, 2006)
- with the implication that no time-invariant parameters can be estimated

A gravity framework

Each equation estimated separately for all goods, intermediate, capital, and consumer goods categories

The seemingly unrelated regression (SUR) method estimates (10), (11), or (12) each as a system across goods categories, accounting for hetero-skedasticity and contemporaneous correlation in errors across categories.

Unobservables could simultaneously affect both intermediate and capital goods trade. However, the same regressors show up in each equation, in which case SUR estimates become equivalent to OLS.

Perform SUR in order to obtain the covariances between the estimates from different equations to properly perform Wald tests.

OLS is a linear operator: estimated coefficients from (11) and (12) sum up to respective estimated coefficient from equation (10).

Gravity regressions for import volumes: OLS with country and period fixed effects

	(7)	(8)	(9)	(10)
	Dependent variable is the log of total import flows of:			
	All goods	Intermediate goods	Capital goods	Consumer goods
Explanatory variables:				
log *GDP_Im*	0.84*** (15.26)	0.74*** (11.18)	0.96*** (13.15)	0.89*** (15.00)
TradeLib	0.15*** (5.46)	0.22*** (6.67)	0.12*** (3.46)	0.048* (1.65)
Wald test [p-value]		[0.0000]***	[0.0211]**	
Observations (cross sections; time)	442 (36; 1992–2004)			
Adj. *R*-squared	0.99	0.99	0.99	0.99

Notes: Fixed effects not reported, *t*-statistics in parentheses; * (**, ***): significance at 10 (5, 1) per cent. By the semi-elasticity nature of the trade liberalisation coefficient, full liberalisation increases imports by ($e^{\beta 2} - 1$). The null hypothesis in the SUR-based Wald tests for trade liberalisation effects is that coefficients are identical between a respective goods category equation and the consumer goods equation.

Gravity regressions for import variety: OLS with country and period fixed effects

	(11)	(12)	(13)	(14)
	Dependent variable is the log of import *variety* of:			
	All goods	Intermediate goods	Capital goods	Consumer goods
Explanatory variables:				
log *GDP_Im*	0.35*** (11.12)	0.30*** (10.21)	0.40*** (10.58)	0.42*** (11.40)
TradeLib	0.10*** (6.54)	0.13*** (8.15)	0.11*** (6.12)	0.048*** (2.63)
Wald test [p-value]		[0.0000]***	[0.0001]***	
Observations (cross sections; time)	442 (36; 1992–2004)			
Adj. *R*-squared	0.98	0.98	0.98	0.98

Gravity regressions for import intensity: OLS with country and period fixed effects

	(15)	(16)	(17)	(18)
	Dependent variable is the log of import *intensity* of:			
	All goods	Intermediate goods	Capital goods	Consumer goods
Explanatory variables:				
log *GDP_Im*	0.49*** (10.92)	0.44*** (6.88)	0.56*** (9.36)	0.47*** (9.29)
TradeLib	0.046** (2.08)	0.085*** (3.29)	0.011 (0.36)	0.00066 (0.03)
Observations (cross sections; time)	442 (36; 1992–2004)			
Adj. *R*-squared	0.99	0.99	0.99	0.99

Results and sensitivity

(1) Substantial institutional trade liberalisation effects on the variety of imported capital goods (and intermediate goods)

(2) The import variety effect of institutional trade liberalisation is significantly higher for capital goods (and intermediate goods) than for consumer goods.

Sensitivity

Measurement of trade liberalisation (Campos and Horvath, 2006)

Alternative way of dealing with heterogeneity: time-variant country dummies (Baier and Bergstrand, 2007)

Conclusions

(1) Is input variety a measure of technology?

Trade-based count measures of available capital goods variety behave "as if" representing technology.

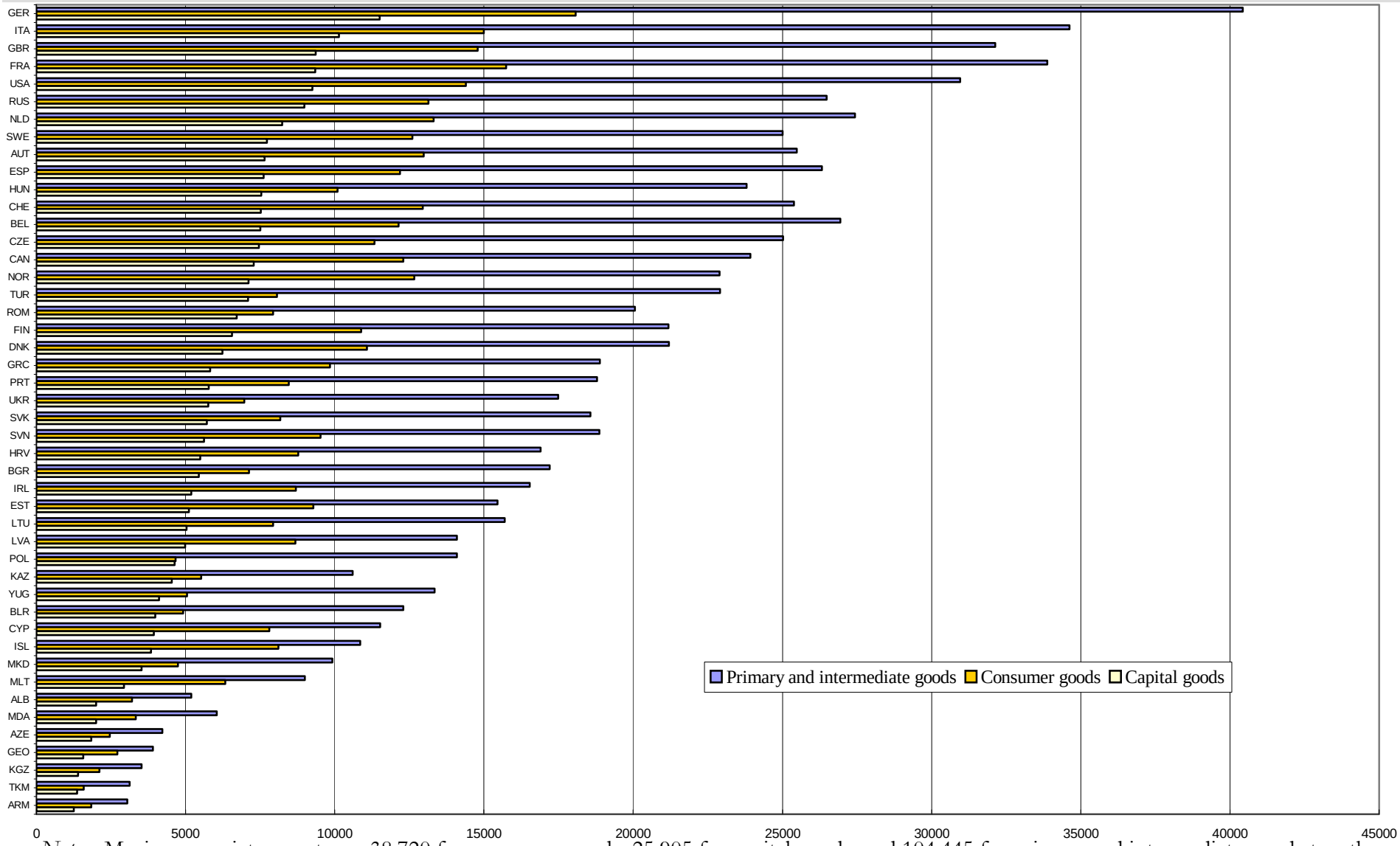
(2) Does trade liberalisation influence input variety?

Institutional trade liberalisation has positive effects on the variety of imported capital goods (and intermediate goods).
These effects are significantly higher than for consumer goods.

Against the background of variety-based growth models, (1) and (2) identify a channel for the link between external reforms and growth: external reforms impact subsequent growth va changing inupt variety, i.e., via changing the state of technology.

More slides

Available product variety by Broad Economic Categories, 2001



Notes: Maximum variety counts are 38,720 for consumer goods; 25,905 for capital goods; and 104,445 for primary and intermediate goods together.
Source: United Nations COMTRADE database and own calculations.

Estimating conditional technological convergence with panel data: Specification

Hauk and Wacziarg (2009), on conditional per capita income convergence: with measurement error,

- within estimators greatly overstate speed of convergence and bias steady state variable estimates towards zero
- estimators using between variation are closer to the true speed of convergence; overestimate steady state variable influence
- between estimator performs best in terms of overall bias

Compromise between data availability and measurement bias:

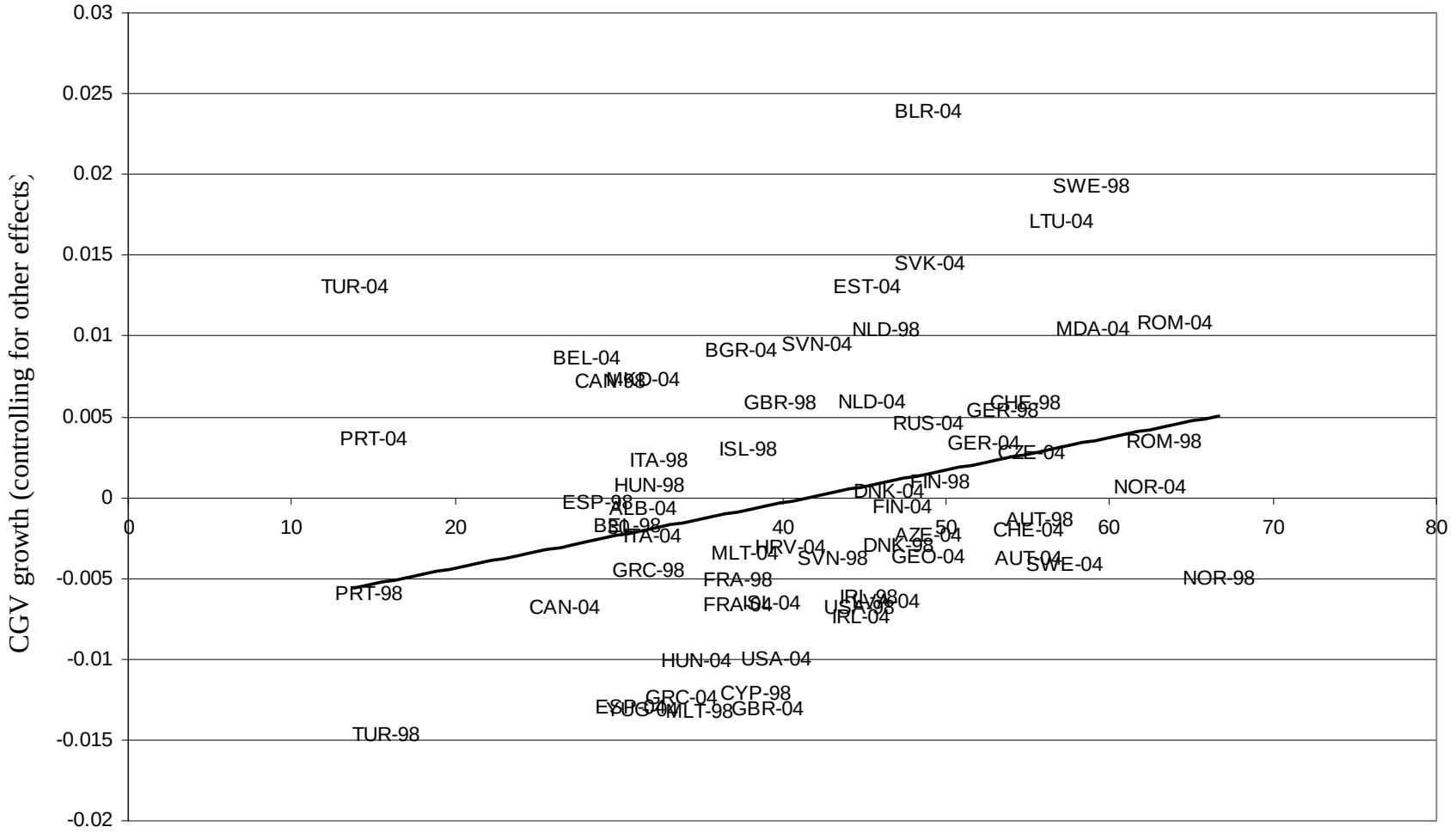
- form two 5-year periods and estimate with 3SLS (Barro and Sala-i-Martin, 2004, ch. 12); measurement bias from initial states dealt with by using lagged initial state variables as instruments
- less prone to measurement bias than other panel estimators, and appropriate when there is both heteroskedasticity and contemporaneous correlation across periods

Product variety growth regressions: small country sample

	(4)	(5)	(6)
	Capital goods	Intermediate goods	Primary goods
Dependent variable:	$(\log CGV_{j,t+T} - \log CGV_{jt})/T$	$(\log IGV_{j,t+T} - \log IGV_{jt})/T$	$(\log PGV_{j,t+T} - \log PGV_{jt})/T$
Explanatory variables:			
Initial variety, log CGV_{jt}	–0.022**		
	(–2.45)		
log IGV_{jt}		–0.045***	
		(–3.99)	
log PGV_{jt}			–0.030***
			(–3.14)
Years of schooling, $schooly\_25_{j,tT}$	0.0017**	–0.00034	–0.0013
	(2.20)	(–0.39)	(–1.05)
Trade liberalisation, $FT\_4plus_{j,tT}$	0.0071**	0.0064*	–0.0073
	(2.17)	(1.72)	(1.35)
Investment-consumption ratio change, $inv\_con_{j,t+T} - inv\_con_{jt}$	0.065***	0.049**	–0.0095
	(3.85)	(2.49)	(0.32)
Size, $GDP1 \times schooly\_25_{j,tT}$	–0.0011**	–0.0023***	–0.0023**
	(–2.61)	(–3.87)	(–2.37)
Banking reform, $BANK\_2plus_{j,tT} \times \log CGV_{jt}$	–0.069***		
	(–5.78)		
$BANK\_2plus_{j,tT} \times \log IGV_{jt}$		0.052***	
		(4.99)	
$BANK\_2plus_{j,tT} \times \log PGV_{jt}$			–0.0073*
			(–1.78)
Observations (1993–98, 1999–2004)	52 (19, 33)	52 (19, 33)	52 (19, 33)
Correlation between subperiod residuals	–0.20	0.11	–0.19
Adj. *R*-squared (1993–98, 1999–2004)	0.51, 0.62	0.54, 0.48	–0.73, 0.26

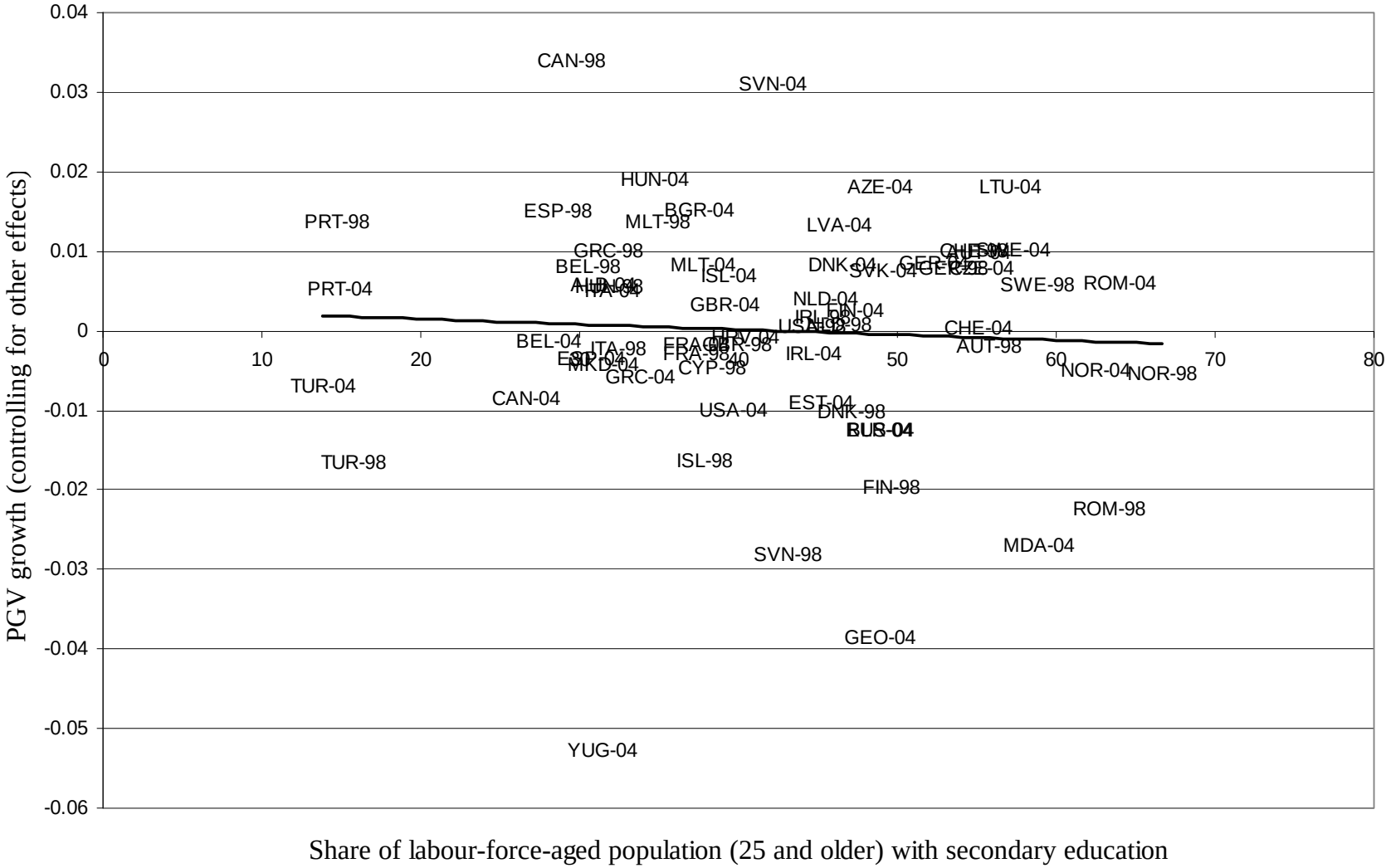
Notes: *t*-stats in parentheses. * (**, ***): significance at 10, (5, 1) per cent. Instruments: one year lagged initial relative product varieties. Interval dummies not reported. Small country sample excludes the six G-7 economies, i.e. US, UK, France, Germany, Italy, Canada.

Partial effects: schooling and CGV growth



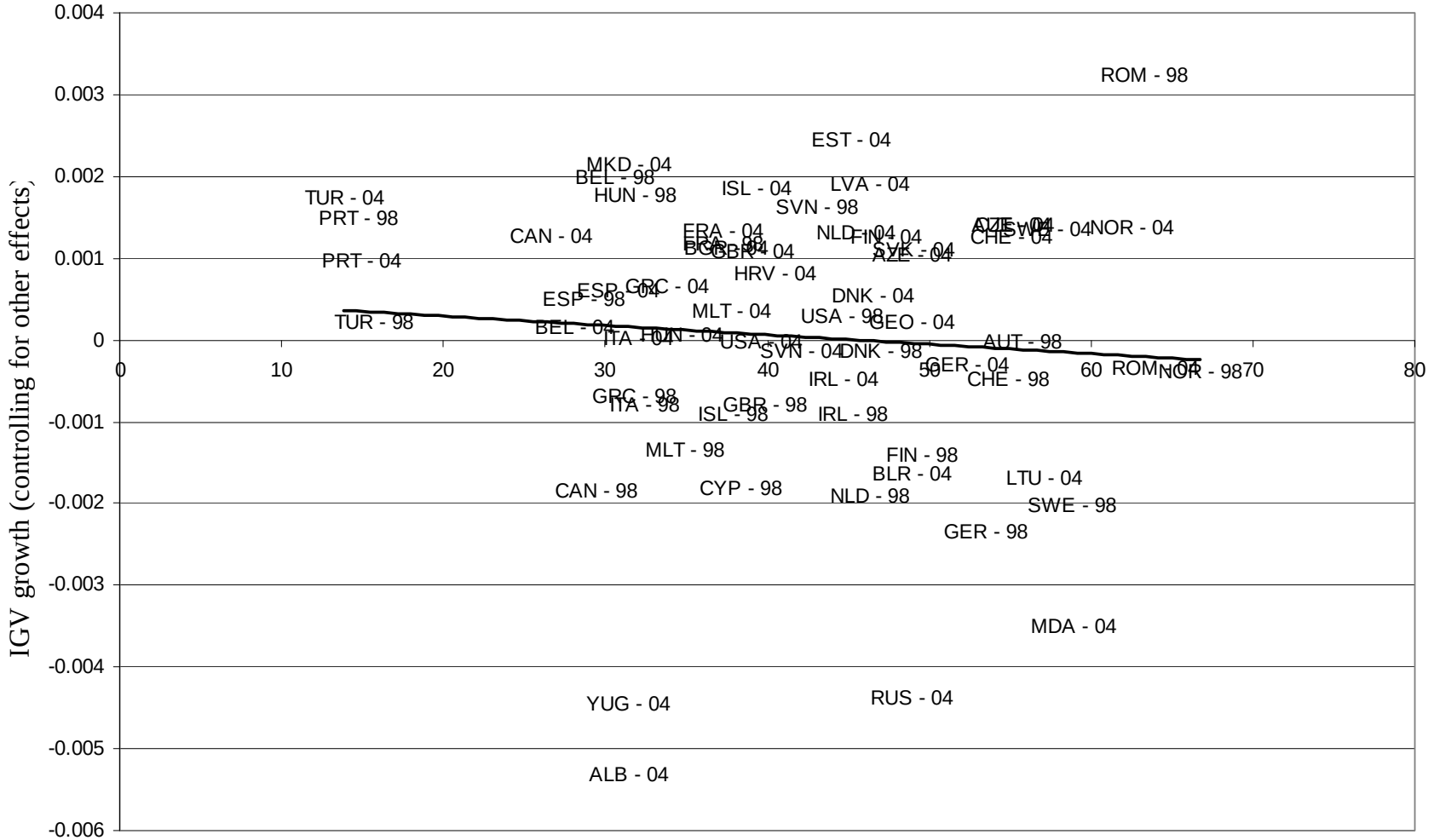
Share of labour-force-aged population (25 and older) with secondary education

Partial effects: schooling and PGV growth



Share of labour-force-aged population (25 and older) with secondary education

Partial effects: schooling and IGV growth



Plausibility

$$(\ln h(t) - \ln h_0)/t = (g - g\ln g + \gamma g \ln H_0) - \gamma g \ln h_0 + g\psi u + g\ln\mu \qquad (9)$$

Learning (4) is consistent with Mincerian wage formation. With structural estimation, the ratio of $-\beta_2/\beta_1$ estimates is an imputed macro-based estimate of a Mincer coefficient, ψ/γ, indicating the percentage real wage rise implied by an additional year of schooling.

- Our range of $-\beta_2/\beta_1$ estimates between 0.06 and 0.10 seem plausible.

The parameter restriction $0 < \gamma \leq 1$ in (4) restricts our estimated β_1 as $0 < -\beta_1 \leq g$, where g is the rate of change of the world technology frontier.

- Our benchmark point estimates, –0.024 and – 0.022 for the full sample and the small country sample, respectively, appear plausible;
- They also underline the importance of the original technology gap in (3): the elasticity of the transitory growth rate of h with respect to the original technology gap (γ) is closer to one than to zero.

Multilateral trade and gravity: complete specialisation

Why analyse import flows along margins within a gravity framework? In which one?

Quick answer to the first question: why not; others also do so, in particular Hummels and Klenow (2005), Crozet and Koenig (2007), Bernard et al. (2007), Felbermayr and Kohler (2007).

Better answers:

- Studying trade variety *versus* intensity presupposes a model with product differentiation, and should be reflected in appropriate data.
- Product differentiation implies complete specialisation, so the question becomes: which gravity approach is appropriate for studying multilateral imports of various goods categories when specialisation is complete?
  - Under fairly general assumptions: the simplest specification applies where total import flows depend on importer income and trade barriers;
  - this in turn, is necessary (but not sufficient) for applying the same specification to margins of imports; sufficient conditions to be identified in specific trade models.

Sensitivity: Measurement of trade liberalisation

Campos and Horvath (2006) present alternative measures of liberalisation for transition economies. I use their cardinal measure of external liberalisation, defined between 0 and 1.

> Campos and Horvath compile 29 variables for external liberalisation, both on capital flows and on trade. Aggregation is as proposed in Lora (1997) with the major advantage that this method does not require to benchmark reform efforts against an ideal well-functioning market economy. Rather, the reference is the maximum reform effort observed in the data. Underlying variables are classified into 'input' and 'outcome' indicators of reform in order to generate input-only measures. This is crucial in terms of addressing endogeneity issues.

Results are comparable to the benchmark results.

Gravity regressions for import variety: OLS with country and period fixed effects

	(19)	(20)	(21)	(22)
	Dependent variable is the log of import *variety* of:			
	All goods	Intermediate goods	Capital goods	Consumer goods
Explanatory variables:				
log *GDP_Im*	0.29*** (8.29)	0.24*** (6.58)	0.33*** (7.89)	0.37*** (8.60)
log *Lora_ext*	0.11*** (4.34)	0.16*** (5.89)	0.14*** (4.44)	0.0065 (0.20)
Wald test [p-value]		[0.0000]***	[0.0000]***	
Observations (cross sections; time)	327 (35; 1992–2001)			
Adj. *R*-squared	0.99	0.99	0.98	0.98

Note: for strictly positive values of *Lora_ext*.

Gravity regressions for import intensity: OLS with country and period fixed effects

	(23)	(24)	(25)	(26)
	Dependent variable is the log of import *intensity* of:			
	All goods	Intermediate goods	Capital goods	Consumer goods
Explanatory variables:				
log *GDP_Im*	0.46*** (8.88)	0.40*** (6.30)	0.49*** (6.67)	0.54*** (9.69)
log *Lora_ext*	0.16*** (4.33)	0.19*** (4.03)	0.022 (0.41)	0.035 (0.85)
Observations (cross sections; time)	327 (35; 1992–2001)			
Adj. *R*-squared	0.99	0.99	0.99	0.99

Sensitivity: 'Time-span-variant' country dummies

Alternative way of dealing with heterogeneity, and perhaps preferred in terms of trade resistance: time-variant country dummies *à la* Baier and Bergstrand (2007).

Go in the direction of Baier and Bergstrand by adding 'time-span-variant' country dummies to period fixed effects. Specifically, select dummies for sub-periods 1992–6, 1997–2000, and 2001–4.

This results in cutting point estimates of liberalisation effects: the advantage of the time-span-variant country dummies' taking better account of country heterogeneity comes at the cost of an increased collinearity between the liberalisation dummy and time-span-variant country dummies.

The qualitative benchmark results remain intact.

Gravity regressions for import variety: OLS with period and time-varying country effects

	(27)	(28)	(29)	(30)
	Dependent variable is the log of import *variety* of:			
	All goods	Intermediate goods	Capital goods	Consumer goods
Explanatory variables:				
log *GDP_Im*	0.31*** (9.26)	0.24*** (7.32)	0.38*** (9.87)	0.41*** (9.86)
TradeLib	0.039*** (2.84)	0.053*** (3.92)	0.042*** (2.65)	0.015 (0.89)
Wald test [p-value]		[0.0010]***	[0.0122]**	
Observations (cross sections; time)	442 (36; 1992–2004)			
Adj. *R*-squared	0.99	0.99	0.99	0.99

Note: time-varying country effects are defined for three sub-periods, 1992–6, 1997–2000, and 2001–4.

Gravity regressions for import intensity: OLS with period and time-varying country effects

	(31)	(32)	(33)	(34)
	Dependent variable is the log of import *intensity* of:			
	All goods	Intermediate goods	Capital goods	Consumer goods
Explanatory variables:				
log *GDP_Im*	0.48*** (11.20)	0.43*** (8.89)	0.57*** (9.36)	0.48*** (9.94)
TradeLib	–0.018 (–1.02)	0.0044 (0.22)	–0.059** (–2.37)	0.0032 (0.16)
Wald test [p-value]				
Observations (cross sections; time)	442 (36; 1992–2004)			
Adj. *R*-squared	0.99	0.99	0.99	0.99

Open questions

- If IGV is not a technological variable, what then is it?

- Derivation of hypothesis (9) was based on a framework without trade, subsequent testing controlled for trade effects.

  Alternative: developing and testing a model that explicitly allows for trade in capital goods varieties.