Is there a Harrod-Balassa-Samuelson effect present in the data? New quarterly panel data evidence from 25 European countries

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Overview

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Motivation

- The productivity based approach in explaining the PPP is an old idea: Harrod (1933), Balassa (1964), and Samuelson (1964).
- However, empirical testing until 2000's was relatively poor, primarily because of lack of suitable and reliable statistical data, and in some way lack of proper econometric tools.
- In recent years due to EU enlargement process and availability of new (or additional) time series data testing of HBS became more popular.

Harrod-Balassa-Samuelson (HBS) hypothesis describes the relationship between productivity and prices. The idea behind it is that the growth in productivity of a tradable sector leads to a rise in the price level of a non-tradable sector.

Literature review and related HBS issues

- Papers mostly focus on HBS effect on cross-country data - EU accession countries (Natalucci and Ravenna, 2002; Mihaljek and Klau, 2008; Cihak and Holub, 2001; Jazbec, 2002; ...) and other emerging economies (Jabeen, Malik and Haider, 2011; Guo and Hall, 2010)
- Different interpretation of productivity: Total factor productivity (Chinn and Johnston, 1997; Kakkar, 2002; De Gregorio et al., 1994; ...) or average productivity of labour (De Gregorio and Wolf, 1994; Žumer, 2002; ...)
- Different estimation methods: mostly OLS and GLS regressions (Coricelli and Jazbec, 2001; ...), dynamic model settings (Masten, 2008; Restout, 2009), cointegration methods (Sonora and Tica, 2009), panel data models (Fischer, 2002; Lojshová, 2003).

Data description

- panel data from 25 European countries available at Eurostat at a quarterly frequency
- time span: from 2001q1 - 2013q4
- dataset includes NACE Rev. 2 breakdown by activity (10 sectors)
- prices, value added aggregates and number of employees for each sector needed
- to divide sectors into tradables and non-tradables WIOD tables considered

Sectoral definition - tradability of activities

NACE Revision 2 10-sector classification of economic activities

NACE Rev. 2	**10-sector breakdown description**
A	Agriculture, forestry and fishing
B,C,D and E	Manufacturing, mining and quarrying and other industry
F	Construction
G, H and I	Wholesale, retail trade; transportation, storage, accommodation, food
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M and N	Professional, scientific, technical, administration and support services
O, P and Q	Public administration, defence, education, human health and social work
R, S, T and U	Other services

Source: Eurostat.

Sectoral definition - tradability of activities (cont'd)

- I follow De Gregorio's (1994) idea of dividing sectors by defining tradeness of activities with ratio of exports (threshold set at 10%) - data available in WIOD's input-output tables
- however, I exclude those sectors from the analysis, which are not distinctively tradable or non-tradable - if they oscillate too much around the 10% threshold
- result: agriculture and fishing (A); information and communication (J); financial activities (K); and professional, scientific and administration activities (M and N) drop out
- tradables: manufacturing (B, C, D, and E); and wholesale and transportation (G, H, and I)
- non-tradables: construction (F); real estate activities (L); public administration (O, P, and Q); and other services (R, S, T, and U)

The baseline model

$$p_{i,t}^{NT} = c_i + \beta_1 A_{i,t}^{TN} + \beta_2 gdp_{i,t} + \beta_3 exp_{i,t} + \beta_4 gov_{i,t} + \beta_5 cap_{i,t} + \nu_t + u_{i,t}, \quad (1)$$

- $p_{i,t}^{NT}$ is the relative price inflation of non-tradable goods to tradable goods $(p_{N,i,t} - p_{T,i,t})$
- $A_{i,t}^{TN}$ is the relative productivity growth of tradable goods to non-tradable goods $(a_{T,i,t} - a_{N,i,t})$
- ν_t are yearly dummies, c_i are country-specific effects and $u_{i,t} = \rho u_{i,t-1} + \varepsilon_{i,t}$ is the error term with an $AR(1)$ process
- other explanatories: $gdp_{i,t}$, $exp_{i,t}$, $gov_{i,t}$, and $cap_{i,t}$

The *vis-à-vis* model

$$
\begin{aligned}
p_{i,t}^{NT} - p_t^{EA12} = c_i + \beta_1 (A_{i,t}^{TN} - A_t^{EA12}) + \beta_2 (gdp_{i,t} - gdp_t^{EA12}) \\
+ \beta_3 (ex_{i,t} - exp_t^{EA12}) + \beta_4 (gov_{i,t} - gov_t^{EA12}) \\
+ \beta_5 (cap_{i,t} - cap_t^{EA12}) + \beta_6 fx_{i,t} + \nu_t + u_{i,t},
\end{aligned}
\tag{2}
$$

- $p_{i,t}^{NT} - p_t^{EA12}$ is the relative price of non-tradable goods to tradable goods of transitional economies *vis-à-vis* EA12 economies
- $A_{i,t}^{TN} - A_t^{EA12}$ is the the relative productivity growth of tradable goods to non-tradable goods of transitional economies *vis-à-vis* EA12 economies
- ν_t are yearly dummies, c_i are country-specific effects and $u_{i,t} = \rho u_{i,t-1} + \varepsilon_{i,t}$ is the error term with an $AR(1)$ process
- other explanatories: $gdp_{i,t} - gdp_t^{EA12}$, $ex_{i,t} - exp_t^{EA12}$, $gov_{i,t} - gov_t^{EA12}$, $cap_{i,t} - cap_t^{EA12}$, and $fx_{i,t}$

Results - baseline model

Results of the baseline model

Regressions no.	1	2	3	4	5
$A_{i,t}^{TN} = a_{T,i,t} - a_{N,i,t}$,	.0450***	.0449***	.0548***	.0259**	.0283**
the HBS effect	(.0105)	(.0105)	(.0186)	(.0125)	(.0136)
$gdp_{i,t}$	.2899***	.2871***	.3098***	.2214***	.2980***
	(.0548)	(.0602)	(.0962)	(.0691)	(.0868)
$exp_{i,t}$	-.0948***	-.0947***	-.1151***	-.0628***	-.0644**
	(.0180)	(.0180)	(.0304)	(.0217)	(.0292)
$gov_{i,t}$	.0231	.0231	.0073	.0684**	.1134**
	(.0206)	(.0206)	(.0339)	(.0276)	(.0463)
$cap_{i,t}$		.0016			
		(.0149)			
Const., year dum.	Yes	Yes	Yes	Yes	Yes
Sector effects	Fixed	Fixed	Fixed	Fixed	Fixed
No. of countries	25	25	9	16	12
Observations	1275	1275	459	816	612
R^2	.1827	.1826	.2172	.1641	.1808
corr(u_i, Xb)	.0099	.0101	-.0235	-.0330	-.0825
$\rho_{AR(1)}$	.5880	.5879	.4986	.6810	.6786

Note: *** p $<$ 0.01, ** p $<$ 0.05, * p $<$ 0.1, std. errors are in brackets

Results - baseline model (cont'd)

Results of the baseline model - precrisis data

Regressions no.	6	7	8	9	10
$A^{TN}_{i,t} = a_{T,i,t} - a_{N,i,t}$,	.0296**	.0296**	.0609**	-.0123	-.0211
the HBS effect	(.0141)	(.0141)	(.0291)	(.0133)	(.0141)
$gdp_{i,t}$	.1554*	.1555*	.2354	.1126	.1709*
	(.0855)	(.0901)	(.1597)	(.0849)	(.1012)
$exp_{i,t}$	-.0831***	-.0832***	-.1136***	-.0288	.0134
	(.0217)	(.0218)	(.0373)	(.0246)	(.0331)
$gov_{i,t}$	-.0083	-.0082	-.0081	.0235	.0580
	(.0264)	(.0265)	(.0436)	(.0371)	(.0668)
$cap_{i,t}$		-.0000			
		(.0210)			
Const., year dum.	Yes	Yes	Yes	Yes	Yes
Sector effects	Fixed	Fixed	Fixed	Fixed	Fixed
No. of countries	25	25	9	16	12
Observations	725	725	261	464	348
R^2	.0773	.0685	.1449	.0235	.0339
corr(u_i, Xb)	.0687	.0685	-.0573	-.0151	-.0999
$\rho_{AR(1)}$	.5170	.5156	.4251	.6358	.6535

Note: *** p $<$ 0.01, ** p $<$ 0.05, * p $<$ 0.1, std. errors are in brackets

Results - baseline model (cont'd)

Results of the baseline model - crisis period data

Regressions no.	11	12	13	14	15
$A_{i,t}^{TN} = a_{T,i,t} - a_{N,i,t}$,	.0599***	.0602***	.0469*	.0913***	.1214***
the HBS effect	(.0160)	(.0160)	(.0240)	(.0243)	(.0269)
$gdp_{i,t}$	.2956***	.3068***	.2956*	.1922	.3060*
	(.0909)	(.0984)	(.1509)	(.1276)	(.1608)
$exp_{i,t}$	-.1339***	-.1341***	-.1527***	-.1029**	-.1462***
	(.0337)	(.0338)	(.0585)	(.0405)	(.0524)
$gov_{i,t}$	.0882**	.0883**	.0992	.0993**	.1610**
	(.0385)	(.0386)	(.0723)	(.0449)	(.0716)
$cap_{i,t}$		-.0066			
		(.0223)			
Const., year dum.	Yes	Yes	Yes	Yes	Yes
Sector effects	Fixed	Fixed	Fixed	Fixed	Fixed
No. of countries	25	25	9	16	12
Observations	525	525	189	336	252
R^2	.1291	.1284	.1212	.1656	.2191
corr(u_i, Xb)	.0538	.0524	.0132	.1613	-.0319
$\rho_{AR(1)}$	.6253	.6254	.5570	.6882	.6750

Note: *** p $<$ 0.01, ** p $<$ 0.05, * p $<$ 0.1, std. errors are in brackets

Results - *vis-à-vis* model

Results of the *vis-à-vis* model

Regressions no.	16	17	18	19	20	21
$A_{i,t}^{TN} - A_t^{EA12}$,	.0583***	.0565***	.0560*	.0554*	.0575**	.0541**
the HBS effect	(.0188)	(.0189)	(.0291)	(.0291)	(.0241)	(.0242)
$gdp_{i,t} - gdp_t^{EA12}$	.3301***	.2789**	.1890	.1673	.4325***	.3456**
	(.1032)	(.1101)	(.1654)	(.1701)	(.1522)	(.1648)
$exp_{i,t} - exp_t^{EA12}$	-.1054***	-.1010***	-.1227***	-.1198***	-.1087	-.1018
	(.0331)	(.0333)	(.0388)	(.0392)	(.0709)	(.0710)
$gov_{i,t} - gov_t^{EA12}$	.0025	.0023	-.0040	-.0040	.0834	.0811
	(.0343)	(.0341)	(.0441)	(.0442)	(.0730)	(.0723)
$fx_{i,t}$	-.0999	-.1033	.0566	.0563	-.3581***	-.3556***
	(.0694)	(.0699)	(.0866)	(.0869)	(.1183)	(.1182)
$cap_{i,t} - cap_t^{EA12}$		.0350		.0222		.0504
		(.0264)		(.0398)		(.0356)
Const., year dum.	Yes	Yes	Yes	Yes	Yes	Yes
Sector effects	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
No. of countries	9	9	9	9	9	9
Observations	459	459	262	262	189	189
R^2	.1534	.1458	.1405	.1329	.1509	.1440
corr(u_i, Xb)	-.0849	-.0838	-.0777	-.0986	-.1511	-.1474
$\rho_{AR(1)}$	.4968	.5060	.4208	.4228	.5391	5516

Note: *** p $<$ 0.01, ** p $<$ 0.05, * p $<$ 0.1, std. errors are in brackets

Conclusions

- Using the fixed effects panel regression estimation I show that the Harrod-Balassa-Samuelson hypothesis is confirmed by sectoral prices and labour productivity data at a quarterly frequency for the 25 European countries.
- The Harrod-Balassa-Samuelson effect is particularly stronger including only the data from transition/accession economies in comparison to the Harrod-Balassa-Samuelson effect which includes the data from developed economies.
- Using only the precrisis data the Harrod-Balassa-Samuelson effect is even stronger in transition/accession countries, while the Harrod-Balassa-Samuelson effect is almost non-existing in the developed countries.
- The Harrod-Balassa-Samuelson effect is also confirmed in a *vis-à-vis* type of model setting, where the Harrod-Balassa-Samuelson effect is tested for the transitional countries and euro area countries as a numeraire country.

Policy implications

- Despite the statistical significance of the Harrod-Balassa-Samuelson effect, the results suggest that it might not play a major role in determining the inflation differential.
- Important economic policy implications for the likes of EU and euro area accession countries and also other transition or emerging economies.
- These countries would have to consider deploying also other economic policy measures or tools to contain the overall inflation.