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Claudius Gräbner, Philipp Heimberger,
and Jakob Kapeller

JOHANNES KEPLER UNIVERSITÄT LINZ
INSTITUTE FOR COMPREHENSIVE ANALYSIS OF THE ECONOMY

Institute for Comprehensive Analysis of the Economy
Johannes Kepler University Linz
Altenbergerstraße 69, 4040 Linz
icae@jku.at
www.jku.at/icae

Export performance, price competitiveness and technology: Revisiting the Kaldor paradox*

Claudius Gräbner[a,b], Philipp Heimberger[a,c], and Jakob Kapeller[a,d]

[a] *Institute for Comprehensive Analysis of the Economy (ICAE) at the Johannes Kepler University Linz, Aubrunnerweg 3a, 4040 Linz, Austria.*

[b] *ZOE. Institute for Future-Fit Economies, Thomas-Mann-Str. 36, 53111 Bonn, Germany.*

[c] *The Vienna Institute for International Economic Studies, Rahlgasse 3, 1060 Vienna, Austria*

[d] *Institute for Socio-Economics at the University Duisburg-Essen, Lotharstr. 65, 47057 Duisburg, Germany*

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Abstract

We reassess the contemporary relevance of the 'Kaldor paradox' (1978), according to which changes in relative unit labor costs as well as relative export prices are positively correlated with advanced countries' export shares in world markets – although conventional trade theory predicts the opposite. Using a sample of 34 OECD countries over the period 1980-2015, we find clear evidence for the continued relevance of Kaldor's paradox. Our findings indicate that the paradox can neither be resolved by pointing to a lack of econometric sophistication in Kaldor's original work nor by exploiting additional data on other major determinants of export success (e.g. technology). A reverse-causality interpretation – according to which export success allows countries to increase relative unit labor costs without substantially reducing international competitiveness – seems most promising for rationalizing the paradox.

*The authors acknowledge funds of the Oesterreichische Nationalbank (OeNB, Anniversary Fund, project number: 17383). For correspondence, you can contact the authors via email: CG: claudius@claudius-graebner.com, PH: heimberger@wiiw.ac.at, JK: jakob.kapeller@jku.at.

1 Introduction

The purpose of this paper is to reassess the contemporary relevance of the 'Kaldor paradox', which goes back to Nicholas Kaldor's study on the link between export performance and price competitiveness (Kaldor, 1978). Kaldor identified 'paradoxical' results for the US, the UK, Japan, Germany and Italy: in these countries, changes in relative unit labor costs (RULC) as well as relative export prices were found to be positively correlated with export shares in world markets. This result stands in contrast to standard trade theory, which would predict a negative relationship between labor costs per unit of output and export success. The contraintuitive relationship suggested by Kaldor (1978) was also confirmed in later studies by estimating models based on levels as well as changes in the respective variables, although more attention has been devoted to the 'level-version' of the Kaldor paradox (see e.g. Carlin et al, 2001; Dosi et al, 2015).

Over the years, three approaches towards resolving the Kaldor paradox have been offered: first, it has been suggested that the paradox is a mere artifact of a now outdated methodology focused on cross-sectional country comparisons. Second, it has been argued that the paradox is due to omitted variable bias as export shares also depend on other factors, e.g. product quality, regulatory requirements or natural and technological endowments. Finally, the paradox could be the result of reverse causality: in this account, higher relative unit labor costs (and a corresponding 'worsening' of price competitiveness) are seen as an endogenous outcome, as export success brings associated gains in output and productivity, which allow for wage expansion (the so-called Kaldor-Verdoorn effects; see Magacho, 2017). In his original paper, Kaldor (1978) mentions the second and third potential explanation for the paradox without much discussion of their relative merit.

Against this backdrop, we reconsider the original findings in Kaldor (1978) by exploiting improved data availability and advances in econometric methodology. Using a sample of 34 OECD-countries over the period 1980-2015, we find clear evidence for the continued relevance of Kaldor's paradox — even when applying more sophisticated econometric approaches and introducing additional control variables to account for potential omitted variable bias. Our results are important as they suggest that the paradox can neither be resolved by pointing to a lack of econometric sophistication nor by incorporating other major determinants of export success such as technology into the regression equation. In light of our findings, the reverse-causality interpretation seems most promising, although further research is needed to substantiate this interpretation.

2 First empirical results

In what follows, we make use of a series of established data sources (details are given in A) to assemble a panel dataset covering 34 OECD countries over 1980-2015 – a time period characterized by a spur in global economic integration.

We start by a) assessing whether the paradox is observable in our pooled sample and proceed by b) considering the question whether the Kaldor paradox is also visible in a more sophisticated panel framework. We follow Kaldor (1978) as closely as possible by employing the export share of countries (relative to total world exports) as the dependent variable and by using relative (nominal) unit labor costs as well as terms of trade as the main explanatory variables. These latter variables represent the two main explanatory dimensions addressed by Kaldor: "relative labor costs per unit of output" and "relative export prices". [1] We estimate our baseline equation in two variants, employing either logarithms of the level-variables or first-differences of the relevant variables. Specifically, we use pooled OLS to estimate the specification:

$$EXP_{i,t} = \alpha + \beta RULC_{i,t} + \gamma TOT_{i,t} + \delta \boldsymbol{Z}_{i,t} + \epsilon_{i,t}, \tag{1}$$

where EXP refers to a country's export share in the world market, $RULC$ are relative unit labor costs.[2] TOT represents the terms-of-trade and $\boldsymbol{Z}$ contains the controls. Models 1-2 and 4-5 in Table 1 summarize the results, which demonstrate the existence of the paradox for both level and first difference specifications, even after controlling for capital accumulation, inflation and growth in export markets (models 2 and 5). The table reports signs contradicting standard trade theory for the two main explanatory variables in all instances, as most parameters show statistical significance. In some sense, our results are even stronger than the original finding, since the latter was based on pointing to four specific countries exhibiting such a pattern, while our approach provides a first step towards an integrated assessment of this relation in a much larger set of OECD countries.

In a next step we take the panel structure of the data into account. To embed the analysis in a panel framework, we conduct a series of specification tests: first, we reject the H_0 of the Hausman test at the 1% level, which suggests using a within estimator. Second, the LM test

[1] The main remaining conceptual difference between Kaldor's original and our approach is Kaldor's focus on the manufacturing sector.

[2] RULC data, obtained from the OECD, account for the structure in both export and import markets of the goods sector. An increase in the index indicates a real effective appreciation.

suggests considering both time as well as country fixed effects. We also use Pesaran's CD and Breusch and Pagan's LM tests to check for cross-sectional dependence, which is clearly present in our data (see appendix). Therefore, conventional standard errors would be biased. To avoid overconfidence in statistical inference, we use clustered standard errors of the Arellano (1987) kind, where every country in our sample represents one cluster.

In sum, this leads to a slight modification of our original specification, which is given by adding the variables ζ_I and η_t to equation (1) to represent country and time fixed effects. Given the large-N-large-T characteristics of the panel, we use OLS to estimate the corresponding models. The results are again reported in Table 1 (models 3 and 6); they indicate that the Kaldor paradox persists even after switching to a well-specified panel: the estimates for RULC remain positive and statistically significant. In the appendix, we replicate all estimations with an alternative measure for price competitiveness (real effective exchange rate based on unit labor costs) and obtain qualitatively similar results.

3 Confounding Factors

One possible explanation for these 'paradoxical' findings could be omitted variable bias. Therefore, we test the impact of three factors that could possibly drive the positive estimate for $RULC$: (1) technological capabilities, (2) natural resources, or (3) the regulatory environment. For doing so, we operationalize technological capabilities by adding the economic complexity index; and we control for a country's endowment with highly valued natural resources (e.g. oil, copper, iron) by including the share of primary sector exports. Finally, we employ the tax-burden as a proxy for the extent of regulatory constraints. Again, the exact specification is informed by the same specification tests as before (see also the appendix) and takes the following form:

$$\begin{aligned} EXP_{i,t} = \beta RULC_{i,t} + \gamma TOT_{i,t} + \delta TECH_{i,t} + \tau PRIMARY_{i,t} + \\ \phi TAXBURDEN_{i,t} + \delta \boldsymbol{Z}_{i,t} + \epsilon_{i,t}, \end{aligned} \tag{2}$$

Even in this setup, the estimates for $RULC$ and TOT both remain positive and significant: the Kaldor paradox persists. This finding implies that estimates that stand in contrast to standard trade theory do not easily disappear when controlling for potential confounding factors, which casts doubt on the hypothesis that the Kaldor paradox simply emerges from omitted

Table 1: The baseline results.

	World export share (diff)			World export share (log)		
	Pooled OLS		Panel	Pooled OLS		Panel
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
RULC (diff)	0.032^{***}	0.008^{***}	0.008^{**}			
	(0.003)	(0.001)	(0.004)			
Terms of trade (diff)		0.006^{***}	0.008^{***}			
		(0.002)	(0.003)			
Trade partner growth (diff)		0.230	3.387^{**}			
		(0.302)	(1.695)			
Inflation (diff)		0.002	0.004^{**}			
		(0.002)	(0.002)			
Capital accumulation (diff)		-0.027^{***}	-0.036^{*}			
		(0.010)	(0.019)			
RULC (log)				1.231^{***}	0.214	0.423^{***}
				(0.186)	(0.232)	(0.154)
Terms of trade (log)					1.003^{***}	0.182
					(0.252)	(0.268)
Trade partner growth (log)					2.538	3.848^{***}
					(1.807)	(1.217)
Inflation (log)					-0.031^{***}	-0.006^{*}
					(0.004)	(0.003)
Capital accumulation (log)					-1.071^{***}	-0.035
					(0.139)	(0.136)
Constant	0.009	-0.009		-5.121^{***}	-2.747^{**}	
	(0.023)	(0.008)		(0.848)	(1.116)	
N	1348	1058	1046	1349	1090	1090
R-squared	0.096	0.058	0.077	0.031	0.115	0.164
Adj. R-squared	0.095	0.054	0.001	0.031	0.111	0.098
Residual Std. Error	0.841	0.269		1.354	1.308	
F Statistic	143.165^{***}	13.035^{***}	16.065^{***}	43.685^{***}	28.153^{***}	39.576^{***}

$^{***}p < .01$; $^{**}p < .05$; $^{*}p < .1$

variable bias. To test for the robustness of our results, we again replicate all estimations with real effective exchange rate ($REER$) as an alternative, integrated measure for price competitiveness replacing both, $RULC$ as well as TOT. The results, which are reported in the appendix, are qualitatively the same.

4 Concluding Thoughts

This paper has shown that the well-known 'Kaldor paradox', which essentially points to a positive association between export performance and prices, thereby contradicting the intuitive predictions of standard trade theory, is still observable. Our estimations show that the Kaldor paradox persists even when we account for the role of technology and other potential confounding factors. This assessment raises two main questions for further research. First, does the Kaldor paradox also hold in a broader (non-OECD) country group? Second, does reverse causality explain the Kaldor paradox, i.e. does success in export markets allow for wage expansions and corresponding increases in relative unit labor costs that do not necessarily hinder export performance?

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Table 2: The results after the inclusion of controls. All variables except trade partner growth and inflation are in logs.

	World export share				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
RULC	0.363***	0.368***	0.319**	0.304**	0.295**
	(0.139)	(0.137)	(0.129)	(0.131)	(0.142)
RULC (lag)	0.083	0.027	0.060	0.105	0.112
	(0.141)	(0.127)	(0.118)	(0.122)	(0.124)
Terms of trade	0.512***	0.549***	0.524***	0.600***	0.561***
	(0.195)	(0.200)	(0.181)	(0.166)	(0.160)
Terms of trade (lag)	−0.305*	−0.191	−0.234	−0.122	−0.106
	(0.182)	(0.163)	(0.152)	(0.134)	(0.132)
Economic complexity		0.039	0.015	0.009	0.003
		(0.090)	(0.099)	(0.094)	(0.096)
Economic complexity (lag)		0.186	0.183	0.170	0.157
		(0.131)	(0.135)	(0.131)	(0.139)
Human capital			0.794	1.919	3.374
			(7.185)	(7.435)	(6.572)
Human capital (lag)			0.640	0.289	−1.262
			(6.991)	(7.334)	(6.487)
Tax burden				−0.251	−0.263
				(0.291)	(0.289)
Tax burden (lag)				−0.555*	−0.541*
				(0.319)	(0.314)
Primary exports					0.017
					(0.175)
Primary exports (lag)					−0.122
					(0.087)
Trade partner growth	4.690***	4.527***	3.778***	3.684***	3.686***
	(1.132)	(1.081)	(1.064)	(1.013)	(1.030)
Inflation	−0.006	−0.006	−0.004	−0.004	−0.003
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Capital accumulation	−0.020	−0.030	0.109	0.012	0.0002
	(0.142)	(0.138)	(0.129)	(0.106)	(0.121)
N	1054	1054	1054	1046	1046
R-squared	0.177	0.193	0.225	0.288	0.296
Adj. R-squared	0.108	0.124	0.157	0.224	0.231
F Statistic	29.830***	25.842***	25.536***	29.868***	26.814***

***p < .01; **p < .05; *p < .1

A Data

Table 3 summarizes the data used and its origins. The data as well as the code for replicating the results of the main paper are available on Github.

Table 3: The data used in the main study.

Variable name	Description	Unit	Source
RULC	Index for relative unit labor costs in the OECD.	index	OECD
TOT	Terms of trade	ratio	OECD
TECH	economic complexity index	index	Atlas of Economic Complexity
HC	Human capital index	index	Penn World Tables
TAXBURDEN	Tax revenue to GDP	Ratio	World Bank
PRIMARY	Share of primary goods in countries total exports	share	Own calculations based on UN COMTRADE
PART.GROWTH	Weighted growth rates of trade partners.	Percent	Own calculations based on IMF DOTS data
INFLATION	Consumer price index for inflation	index	OECD
CAP.ACCU	Gross fixed capital formation/net captal stock	ratio	AMECO, own calculations
REER	Real effective exchange based on ULC	Index	IMF International Financial Statistics
RD	Gross domestic expenditure on R&D per capita	current PPP $ per capita	OECD, own calculations
EXP	Share of own exports of world exports.	ratio	UN COMTRADE

B Specification tests

Table 4 reports the results for the specification tests that led to the specifications estimated in the main paper.

C Robustness checks

Here we provide some robustness checks for the findings of the main paper. An alternative (but inferior) measure for price competitiveness is the relative effective exchange rate based on unit labor costs (REER). Tables 5 and 6 replicate tables 1 and 2 of the main paper using REER instead of RULC. Because REER is very similar to and highly correlated with the terms-of-trade, the latter variable has been removed for these regressions. In all cases, the basic identification of the paradoxical sign of the costs variable remains highly significant.

Hausmann test		
Model	$p-value$	χ^2**-statistic**
Section 2, Model 3	<0.01	20.7148
Section 2, Model 6	<0.01	94.9698
Section 3, Model 1	0.0101	18.4379
Section 3, Model 2	<0.01	48.7408
Section 3, Model 3	<0.01	68.8251
Section 3, Model 4	<0.01	108.8382
Section 3, Model 5	<0.01	49.7057
LM-Test for time effects		
Model	$p-value$	**F-statistic**
Section 2, Model 3	0.9642	0.6437
Section 2, Model 6	<0.01	1.6655
Section 3, Model 1	<0.01	1.8901
Section 3, Model 2	<0.01	2.0801
Section 3, Model 3	<0.01	2.9856
Section 3, Model 4	<0.01	2.8370
Section 3, Model 5	<0.01	2.6980
Breusch and Pagan's LM test		
Model	$p-value$	χ^2**-statistic**
Section 2, Model 3	<0.01	1184.6438
Section 2, Model 6	<0.01	4175.0117
Section 3, Model 1	<0.01	3891.8147
Section 3, Model 2	<0.01	3989.0720
Section 3, Model 3	<0.01	3978.7753
Section 3, Model 4	<0.01	3424.8438
Section 3, Model 5	<0.01	3496.0658
Pesaran's CD test		
Model	$p-value$	**z-statistic**
Section 2, Model 3	<0.01	3.0879
Section 2, Model 6	<0.01	-6.2527
Section 3, Model 1	<0.01	-5.7309
Section 3, Model 2	<0.01	-5.9154
Section 3, Model 3	<0.01	-5.4003
Section 3, Model 4	<0.01	-4.6341
Section 3, Model 5	<0.01	-4.5010

Table 4: Results for the specification tests used in main paper.

Table 5: A replication of table 2 with REER as an alternative measure for price competitiveness.

	World export share (diff)			World export share (log)		
	Pooled OLS		Panel	Pooled OLS		Panel
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
REER (diff)	0.022***	0.015***	0.015**			
	(0.002)	(0.002)	(0.006)			
Trade partner growth (diff)		−0.349	−0.868			
		(0.458)	(1.042)			
Inflation (diff)		0.001	0.004			
		(0.011)	(0.013)			
Capital accumulation (diff)		0.0002	−0.008			
		(0.030)	(0.028)			
REER (log)				0.689**	0.304	0.382***
				(0.298)	(0.322)	(0.143)
Trade partner growth (log)					4.509*	0.922
					(2.523)	(0.743)
Inflation (log)					−0.209***	−0.001
					(0.043)	(0.009)
Capital accumulation (log)					0.637**	−0.051
					(0.277)	(0.139)
Constant	−0.023*	−0.024*		−2.379*	−1.585	
	(0.014)	(0.013)		(1.366)	(1.606)	
N	495	408	405	518	430	430
R-squared	0.185	0.093	0.091	0.010	0.068	0.156
Adj. R-squared	0.184	0.084	−0.017	0.008	0.059	0.060
Residual Std. Error	0.306	0.253		1.150	1.125	
F Statistic	112.276***	10.284***	9.044***	5.366**	7.720***	17.830***

***p < .01; **p < .05; *p < .1

Table 6: A replication of table 2 with using REER instead of RULC. As before, all variables except trade partner growth and inflation are in logs.

	World export share				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
REER	0.526***	0.532***	0.512***	0.516***	0.506***
	(0.149)	(0.157)	(0.144)	(0.147)	(0.146)
REER (lag)	−0.117	−0.211	−0.166	−0.162	−0.167
	(0.176)	(0.169)	(0.158)	(0.159)	(0.156)
Economic complexity		−0.211***	−0.149***	−0.146***	−0.161***
		(0.043)	(0.038)	(0.043)	(0.042)
Economic complexity (lag)		−0.081*	0.005	0.008	−0.002
		(0.048)	(0.053)	(0.054)	(0.062)
Human capital			7.245*	7.065*	6.848*
			(4.173)	(4.223)	(3.904)
Human capital (lag)			−9.827**	−9.597**	−9.202**
			(4.291)	(4.370)	(3.957)
Tax burden				0.027	0.019
				(0.192)	(0.191)
Tax burden (lag)				−0.110	−0.147
				(0.288)	(0.246)
Primary exports					−0.106
					(0.151)
Primary exports (lag)					−0.013
					(0.094)
Trade partner growth	0.765	0.522	0.826	0.796	0.525
	(0.760)	(0.870)	(0.834)	(0.856)	(0.854)
Inflation	0.0001	−0.003	−0.001	−0.001	−0.001
	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)
Capital accumulation	−0.080	−0.132	−0.227*	−0.230**	−0.258**
	(0.128)	(0.128)	(0.119)	(0.112)	(0.128)
N	406	406	406	406	406
R-squared	0.171	0.257	0.345	0.346	0.353
Adj. R-squared	0.070	0.162	0.257	0.254	0.258
F Statistic	14.938***	17.755***	20.937***	17.088***	14.829***

***p < .01; **p < .05; *p < .1