

**Trade Invoicing in the Accession Countries:
Are They Suited to the Euro?**

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The views in this paper are those of the authors and do not necessarily reflect the position of the
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- Big picture. Accession countries are moving more toward the euro. Should the euro be the currency used in invoicing their international transactions?
- Paper focuses on exporter decisions. An exporter can choose between using:
 - her own currency (producer's currency pricing, PCP),
 - the currency of the destination country (local currency pricing, LCP),
 - a non-counterparty currency (vehicle currency pricing, VCP),
- Which is best is not straightforward.
- We'll explore the theory, and then the empirics of the application to accession countries. Wrong choice implies volatile and lower expected profits, lower welfare.

Rich History of Thought on Drivers of Invoice Currency in Trade

- **Role of transaction costs and foreign exchange market liquidity.**
 - Currencies with low transaction costs have a prominent role (Swoboda 1968, 1969; Devereux and Shi, 2005).
 - Presence of thick market externality (Rey, 2001).
- Inertia in invoicing. Once a currency is established in a dominant role, little or no incentive for a firm to invoice in another currency (Krugman, 1980).

- Role of **macroeconomic fundamentals** - compare shocks / volatility across countries. (Giovannini, 1988).
- Incentive to set the price in the currency with the most stable fundamentals (Bacchetta and vanWincoop, 2003, Devereux, Engel and Storegaard, 2004, Oi, Otani, and Shirota, 2004).
- Role of **industry characteristics**. Industries where goods are homogeneous and traded in specialized markets likely to be invoiced in a single low transaction cost currency (McKinnon, 1979, Goldberg and Tille, 2005).

- Goldberg and Tille (2005), building on Devereux, Engel, Storegaard (2004), show in a three currency world that two forces should influence the choice of invoicing currency: “**herding**” and “**hedging**”.
- **Herding dominates for more uniform and homogeneous goods**
- Logic: a producer should invoice so that, after exchange rate fluctuations, his price does not deviate from competitors’ prices and cause fluctuations in demand for his good. In a decreasing returns to scale environment, these output fluctuations lead to higher expected costs. Especially for highly substitutable goods, and producers with very convex costs, there is a strong incentive for producers of a particular type of good to all herd in the currency chosen for invoicing trade transactions.

- **Hedging matters mainly for the invoicing of differentiated goods.**
- Logic: demands for a producer's goods are subject to destination market business cycles and to wage and cost shocks. When an invoicing currency is chosen, the producer introduces some extra exchange rate volatility and relative price volatility into his revenue considerations. This volatility also influences marginal costs due to decreasing returns to scale.
- Optimally hedge by choosing an invoice currency so that the revenue fluctuations attributable to exchange rate movements work to hedge some shocks to production costs, insulating overall profits from some shocks.
- Any unhedged risk can always be covered (at a cost) in forward markets.

The exposition in my paper and presentation takes the perspective of accession country exporters. Relationships with the euro and the dollar are emphasized. Paper appendix also provides results for importers.

Preview of empirical findings for the accession countries

- A lot of cross-country heterogeneity in invoicing.
- More than 50 percent of export invoicing uses euros, dollars on ~ 25 percent.
- Euro use in invoicing has been increasing.
- Dollar use declining, even for countries with “surprisingly” low use of dollars.
- Accession country exports are mainly to the euro area and rest of Europe.

- U.S. and “dollar bloc countries” typically account for less than 5 % of exports.
- Composition is heavily toward differentiated goods - 60 to 85 % of exports.
- Remaining exports in “reference priced goods”, for example paper, or “organized exchange traded goods” like copper and aluminum. Much of the latter types of exports have dollar pricing worldwide.

Applying the lessons of the theoretical work yields the following conclusions

- **7 accession countries use dollars less frequently in invoicing than predicted.**
- **3 countries also use euros more than predicted.**
- These results presume that **the dollar the key vehicle currency on reference priced and exchange traded goods in Europe, as it is elsewhere.**
- If so, **some accession countries may have moved further toward the euro and away from the dollar in trade invoicing than desirable** in terms of maximizing expected profits and keeping the volatility of such profits low.

A simple theoretical model

- Prices are set in advance, can be moved by the exchange rate ex-post.
- Three currencies available for invoicing: 1) the exporter's currency, 2) the local currency of the destination market, 3) a vehicle currency.
- Technology: Firm producing brand z , located in country e , selling to country d . Technology decreasing returns to scale, parameter α .

$$Y_{ed}(z) = \frac{1}{\alpha} [H_{ed}(z)]^{\alpha}, \quad 0 < \alpha \leq 1$$

- Demand: For brand z driven by relative prices and overall demand:

$$Y_d(z) = \left[P_{ed}(z) / P_d \right]^{-\lambda} C_d$$

$P_{ed}(z)$: price (currency d) paid by the consumer for brand z ; P_d : price index (currency d) over all brands. λ is elasticity of substitution.

Invoicing

Firm chooses a price $P_{ed}^k(z)$ in currency k to maximize his expected profits.

The invoice currency choice introduces exchange rate effects that can alter is prices relative to those of his competitors, and move demand for his good.

$$\Pi_{ed}^k(z) = ED_e \left\{ S_{ek} P_{ed}^k(z) \left[\frac{S_{ek} P_{ed}^k(z)}{S_{ed} P_d} \right]^{-\lambda} C_d - W_e (\alpha)^{\frac{1}{\alpha}} \left[\frac{S_{ek} P_{ed}^k(z)}{S_{ed} P_d} \right]^{-\lambda} C_d \right\}^{\frac{1}{\alpha}}$$

- $k=e$: producer currency pricing (PCP),
- $k=d$: local currency pricing (LCP),
- $k=v$: vehicle currency pricing (VCP).

Optimal Invoicing Solution

- With variables defined in log deviations around steady state, the producer's relative price weights differences between the brand price and price index:

$$q_{ed}^k = \left(\beta_d^d - \eta_d^d \right) s_{ed} + \left(\beta_d^v - \eta_d^v \right) s_{ev}$$

- Full stabilization of relative prices requires replicating the currency composition of the index.
- Choose β_d^d , β_d^v and $\beta_d^e = 1 - \beta_d^d - \beta_d^v$ to maximize expected profits:

$$\beta_d^d = \Omega \eta_d^d + (1-\Omega) \rho(m_{ed}, s_{ed}) \quad ; \quad \beta_d^v = \Omega \eta_d^v + (1-\Omega) \rho(m_{ed}, s_{ev})$$

$$m_{ed} = w_e + \frac{1-\alpha}{\alpha} c_d$$

- PCP is attractive as it fully stabilized unit revenue in exporter's currency.

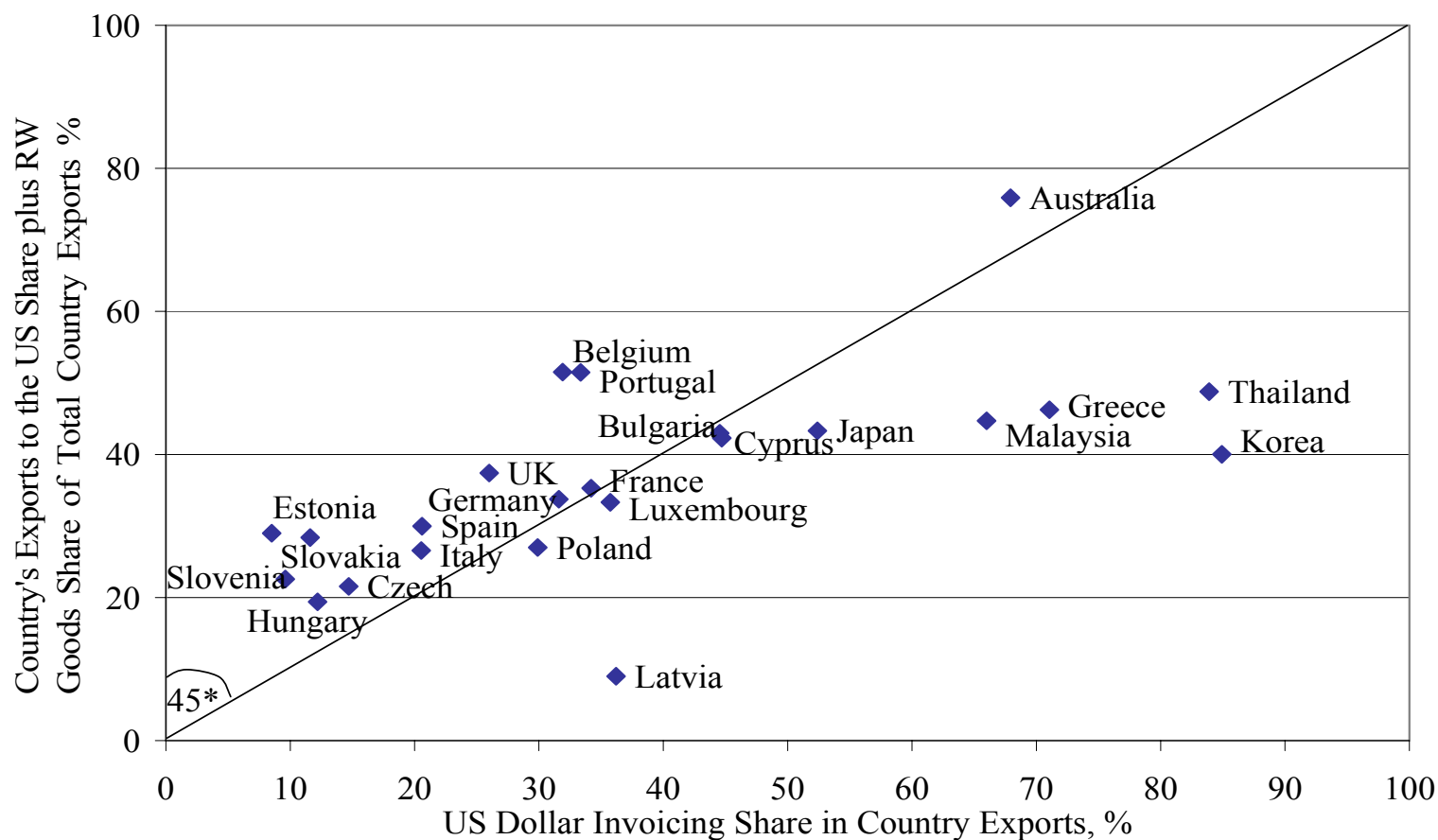
Two reasons to deviate from PCP.

- Herding: $\beta_d^d = \Omega \eta_d^d + \dots$. Keep price in line with competitors to limit output fluctuations. More important when goods are highly substitutable and / or marginal costs are more convex. Ω can easily be substantial. $\Omega = \frac{\lambda(1-\alpha)}{\alpha + \lambda(1-\alpha)}$

- Hedging: $\beta_d^d = \dots + (1-\Omega) \rho(m_{ed}, s_{ed})$. OLS regression of the cost m_{ed} on the exchange rates s_{ed} and s_{ev} : $m_{ed} = \rho(m_{ed}, s_{ed}) \cdot s_{ed} + \rho(m_{ed}, s_{ev}) \cdot s_{ev}$

Application of Invoicing Theory to Accession Country Exports

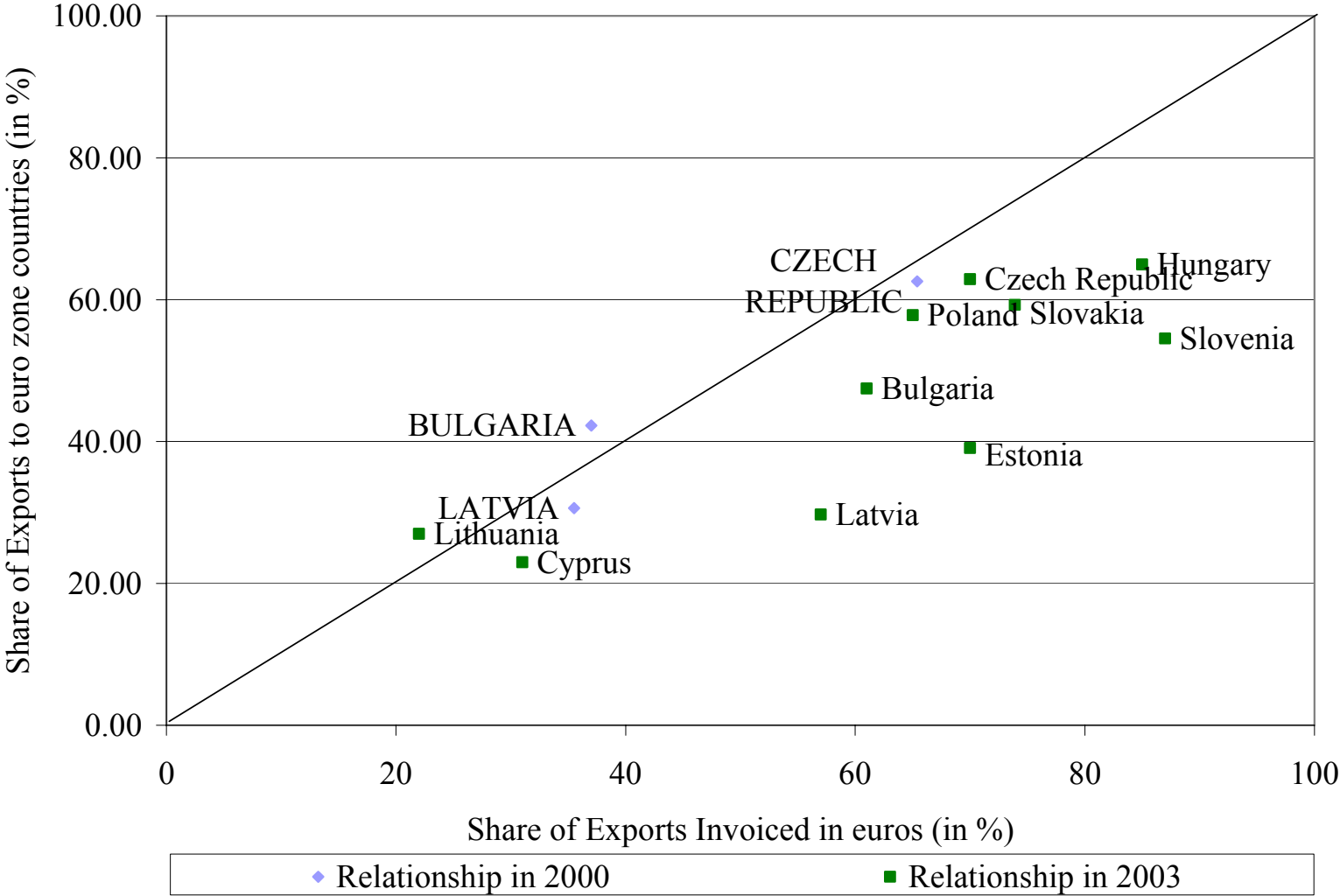
Dollar invoicing patterns, measured relative to country exports to the US and exports of Commodity Type goods to the rest of the world



Source: DOTS and various national sources

Euro-area country data, with the exception of Italy data, refer to extra-euro area trade and invoicing

Export Invoicing in Euros has risen and exceeds exports to the Euro Zone



Most of accession country exports are to the euro area and rest of Europe. The euro appears to be used on much of accession exports to the rest of Europe.

<i>Country</i>	<i>Euro Area</i>	<i>All Europe</i>	<i>United States</i>	<i>East Asia</i>	<i>Other Dollar Bloc</i>	<i>All Dollar Bloc</i>
Bulgaria	51.3	85.3	6.1	1.4	1.6	9.0
Cyprus	23.0	64.0	1.9	1.7	1.2	4.8
Czech Republic	62.9	93.2	2.5	1.1	0.7	4.3
Estonia	39.1	92.8	2.4	1.6	0.9	4.9
Hungary	65.0	91.7	3.2	0.9	0.7	4.8
Latvia	29.7	92.3	2.9	0.8	1.1	4.8
Lithuania	27.0	94.5	2.8	0.8	0.6	4.2
Malta	23.9	39.8	11.7	14.4	1.8	27.9
Poland	57.8	93.2	2.2	0.9	1.2	4.1
Slovakia	59.3	92.7	4.6	0.7	0.8	6.1
Slovenia	54.5	92.3	3.7	0.6	0.8	5.1

Export shares by trading partner, 2003. Source: IMF, *Direction of Trade Statistics*

The composition of Accession country exports is heavily skewed towards differentiated goods (About $\frac{3}{4}$). The other $\frac{1}{4}$ are in reference-priced or organized exchange traded goods, which worldwide are often priced & invoiced in dollars.

<i>Country</i>	<i>Differentiated</i>	<i>Reference-Priced</i>	<i>Organized Exchange</i>
Bulgaria	64.9	20.5	14.7
Cyprus	61.7	30.6	7.7
Czech Republic	83.0	14.5	2.5
Estonia	70.2	26.0	3.8
Hungary	81.8	13.7	4.5
Latvia	64.8	30.1	5.1
Lithuania	68.2	25.6	6.2
Malta*	80.3	6.3	13.4
Poland	75.5	18.7	5.8
Slovakia	82.0	14.6	3.4
Slovenia	80.8	16.7	2.5

* Source: Trade data from UN Comtrade, and author's calculations. Malta data from 2000. (2003 Composition, using the Rauch classification indices applied to detailed country exports).

If reference priced and organized exchange traded goods are priced in dollars by other producers, the dollar share in exports is low for accession countries

	<i>RW share in exports</i>	<i>Observed dollar invoicing share</i>	<i>Dollar bloc share in exports</i>	<i>Hedging in favor of dollar on Europe trade?</i>	<i>Is dollar share lower than predicted?</i>
Bulgaria	35.1	44.5*	7.3		NO
Cyprus	38.3	44.7*	4.8		NO
Czech R.	17.0	14.7*	4.2		YES
Estonia	29.8	8.5	4.8		YES
Hungary	18.2	12.2*	4.7		YES
Latvia	35.2	32.1*	4.8		YES
Lithuania	31.8		4.2		--
Malta	--		27.8		--
Poland	24.5	29.9*	4.3		NO
Slovakia	18.0	11.6*	6.1		YES
Slovenia	19.2	9.6*	5.1		YES

* Dollar share data from 2002 instead of 2003 Source: Trade data from UN Comtrade, author's calculations; IMF, *Direction of Trade Statistics*; individual country sources (details in appendix).

I apply the hedging arguments to accession country exports to different destinations, and test which currency, dollars or euros, better hedges profits against accession cost fluctuations. The dollar dominates for exports to the US, and Poland's exports to Europe; Euros for Bulgaria and Estonia on exports to Europe.

	US as export destination	Euro area as destination	Other Europe as destination
	<i>Regression coefficient</i> $\rho(m_{edus}, S_{edollar})$ $-\rho(m_{edus}, S_{e,euro})$	<i>Regression coefficient</i> $\rho(m_{edeuroz}, S_{edollar})$ $-\rho(m_{edeuroz}, S_{e,euro})$	<i>Regression coefficient</i> $\rho(m_{edotherEU}, S_{edollar})$ $-\rho(m_{edotherEU}, S_{e,euro})$
Bulgaria	-0.51	-1.52**	-1.33**
Czech Republic	0.97**	-0.07	0.17
Estonia	-1.32	-2.28***	-2.87***
Hungary	0.97**	-0.06	0.23
Latvia	0.80***	-0.25	0.09
Lithuania	1.17***	0.07	0.50
Poland	1.59***	0.52*	0.90***
Slovakia	0.73	-0.35	0.15
Slovenia	1.33**	0.07	0.44

Note: Assumes $\alpha = 0.65$. *, **, and *** significance at 10, 5, and 1 percent levels.

Hedging considerations change the prediction only in the case of Poland.

	<i>RW share in exports</i>	<i>Observed dollar invoicing share</i>	<i>Dollar bloc share in exports</i>	<i>Hedging consideration in favor of dollar on Europe trade?</i>	<i>Is dollar share lower than predicted?</i>
Bulgaria	35.1	44.5*	7.3	NO	NO
Cyprus	38.3	44.7*	4.8	--	NO
Czech Republic	17.0	14.7*	4.2	--	YES
Estonia	29.8	8.5	4.8	NO	YES
Hungary	18.2	12.2*	4.7	--	YES
Latvia	35.2	32.1*	4.8	--	YES
Lithuania	31.8		4.2	--	--
Malta	--		27.8	--	--
Poland	24.5	29.9*	4.3	YES	NO⇒YES
Slovakia	18.0	11.6*	6.1	--	YES
Slovenia	19.2	9.6*	5.1	--	YES

* Dollar share data from 2002 instead of 2003

Source: Trade data from UN Comtrade, author's calculations; IMF, *Direction of Trade Statistics*; individual country sources (details in appendix).

Euro Invoicing Share of Exports is Higher than Predicted for 3 Countries

	<i>RW share in exports</i>	<i>Euro zone share in exports</i>	<i>All Europe share in exports</i>	<i>Observed euro invoicing share</i>	<i>Currency Favored for hedging EU trade?</i>	<i>Is euro share higher than predicted?</i>
Bulgaria	35.1	51.3	85.3	52.0	Euro	NO
Cyprus	38.3	23.0	64.0	21.8	--	--
Czech	17.0	62.9	93.2	68.8	--	--
Estonia	29.8	39.1	92.8	70.0	Euro	NO
Hungary	18.2	65.0	91.7	83.0	--	YES
Latvia	35.2	29.7	92.3	47.7	--	--
Lithuania	31.8	27.0	94.5	22.0	--	--
Malta	--	23.9	39.8		--	--
Poland	24.5	57.8	93.2	60.0	Dollar	YES
Slovakia	18.0	59.3	92.7	73.9	--	
Slovenia	19.2	54.5	92.3	87.0	--	YES

2003 data. maximum theoretical prediction= (all Europe share) (1-RW share). Source: Trade data from UN Comtrade, and author's calculations; IMF, *Direction of Trade Statistics*; individual country sources

IV. Concluding remarks

Analysis of herding and hedging influences on invoicing predicts:

- dollar use on invoicing accession country exports appears to be too low for the Czech Republic, Estonia, Latvia, and Slovakia, without the euro share being predicted to be too high
- euro share too high in the exports of Hungary, Poland, and Slovenia.

The model predicts herding considerations to dominate hedging considerations.

Herding is industry-specific, not country-specific.

The model does not predict which currency will be used for herding.

Open issues for discussion

In recent decade, much of the herding in invoicing homogeneous / highly substitutable goods has been done using the U.S. dollar.

What types of developments could lead to an unseating of the dollar in its vehicle currency role? How much of this is already underway?

In theoretical analyses, different assumptions will likely lead to different predictions (transaction costs v. macro volatility?; integrated v. segmented international markets?)

This issue needs more work.

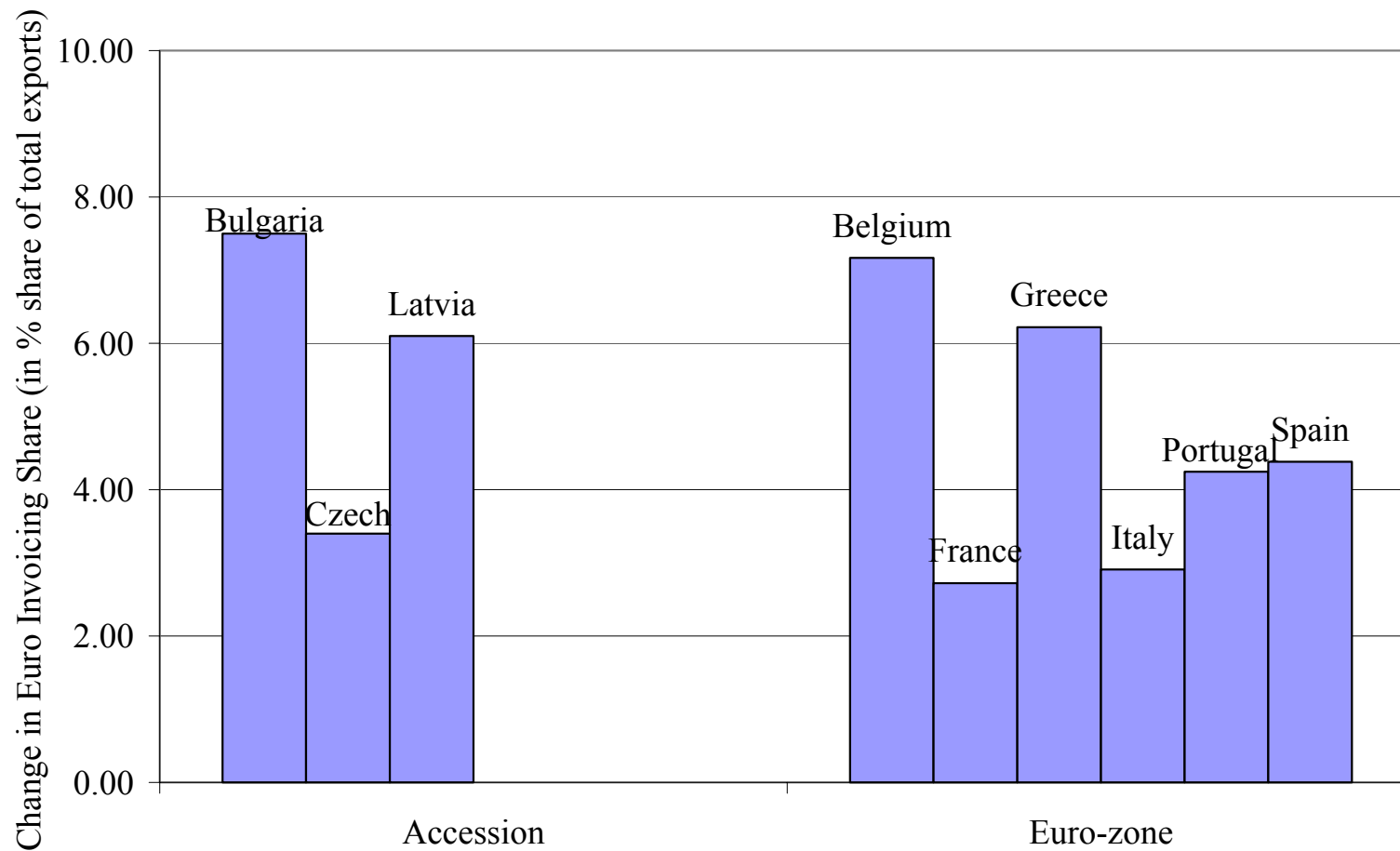
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Dollar and Euro Shares of Trade Invoicing in Accession Countries, 2002

	Exports		Imports	
	<i>Euro Share</i>	<i>Dollar Share</i>	<i>Euro Share</i>	<i>Dollar Share</i>
average:	58.6	23.1	58.5	27.6
Bulgaria	52.0	44.5	60.0	37.1
Cyprus	21.8	44.7	45.5	34.9
Czech Republic	68.8	14.7	65.0	19.5
Estonia†	70.0	8.5	61.0	22.0
Hungary	83.0	12.2	73.0	18.5
Latvia **	47.7	32.1	47.7	32.1
Lithuania†	22.0		53.0	
Malta			34.7	48.8
Poland	60.0	29.9	60.0	28.6
Slovakia	73.9	11.6	60.1	21.2
Slovenia	87.0	9.6	83.0	13.3

data from 2001 instead of 2000† data from 2003 instead of 2002, ** Latvian data are for invoicing of imports and exports combined

Average Annual Rise in Euro Invoicing of Exports, 2000-2002*

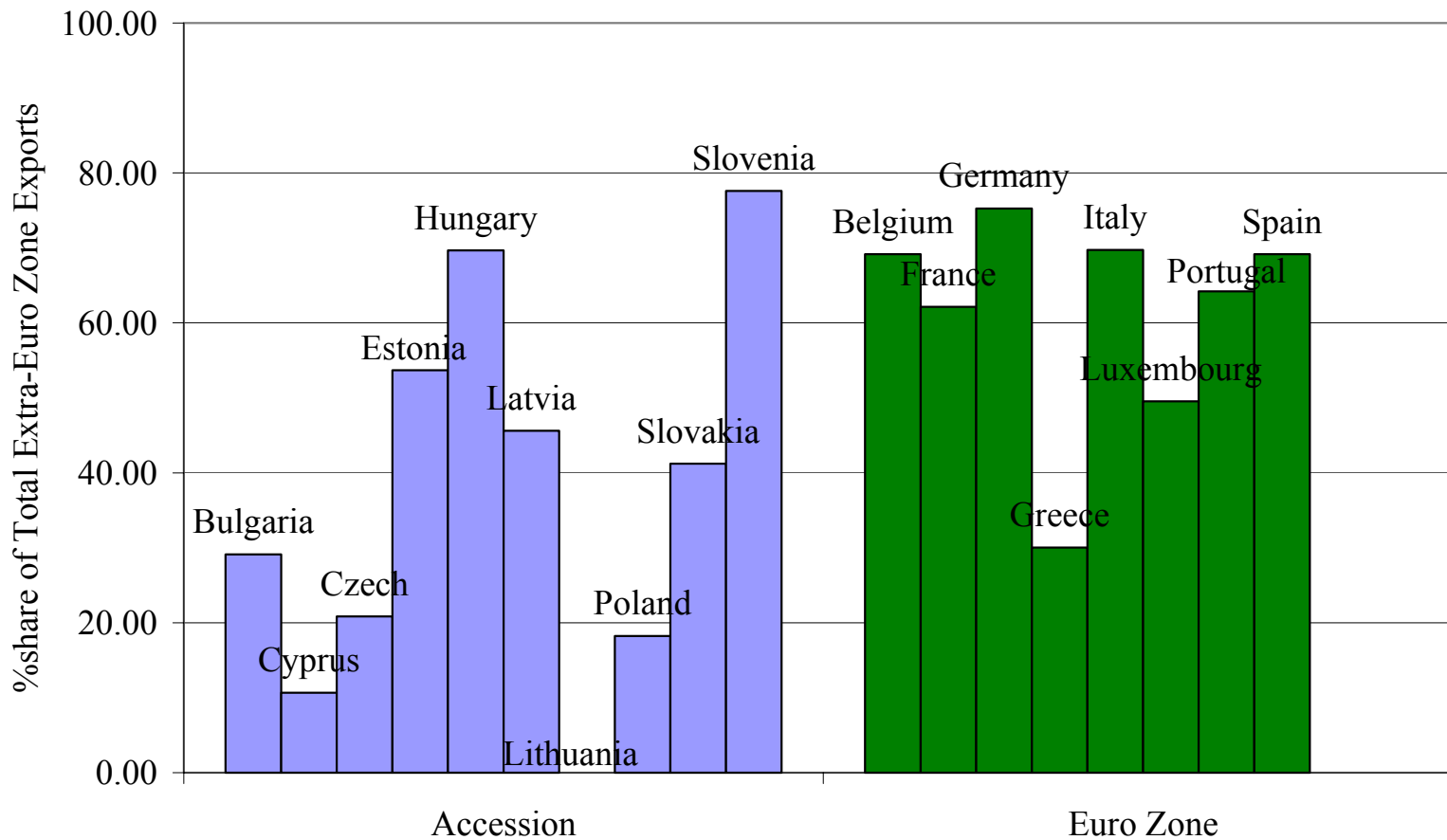


* or longest available period.

The data cover all exports for accession countries and Italy; otherwise, extra euro area exports.

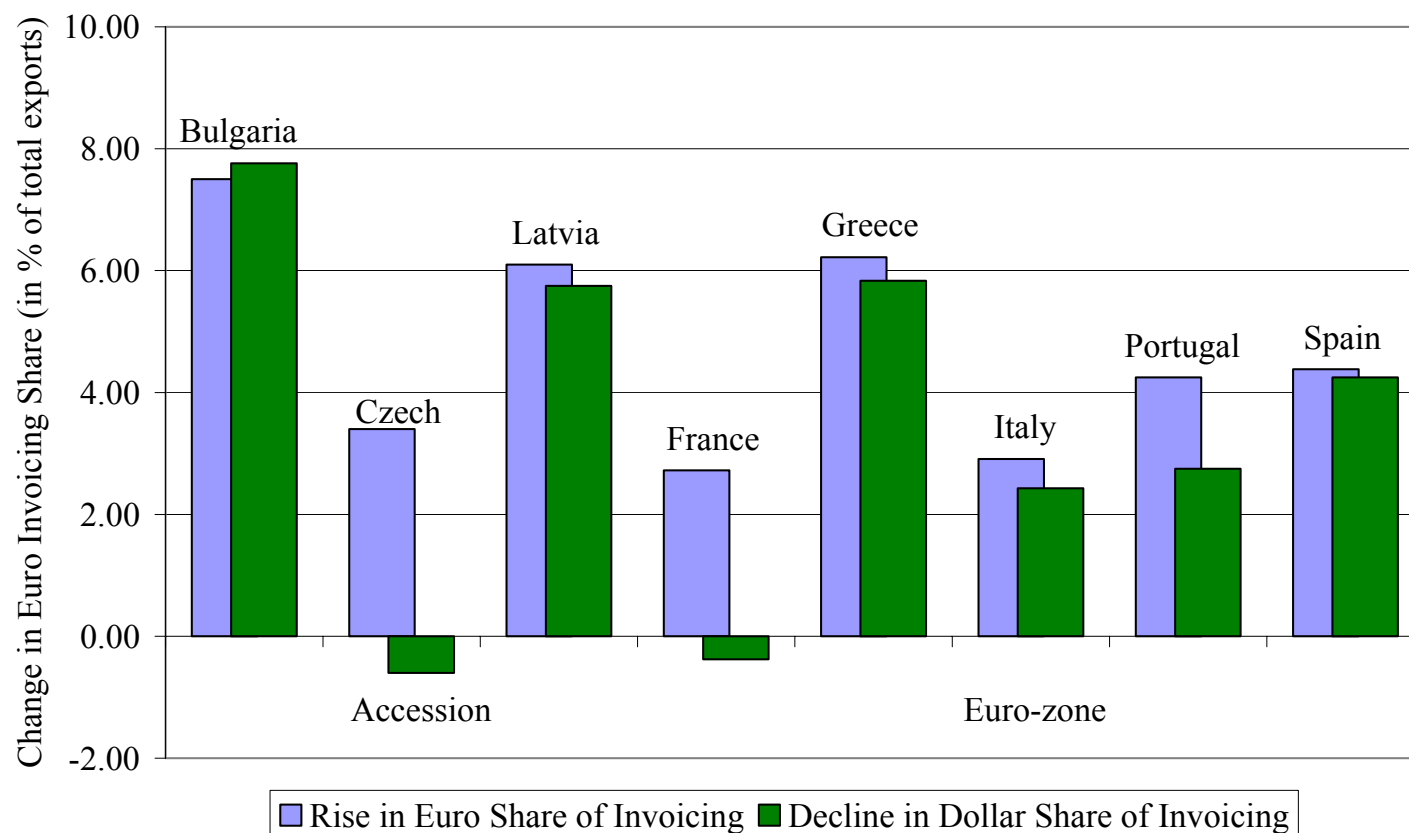
Source: Author's calculations using data from the ECB report and local country sources (details in paper)

Euro Invoicing Share of extra-Euro Zone Exports, 2003*



* With Accession country shares estimated assuming that 100% of exports to the euro zone are invoiced in euros and 100% of exports to the U.S. are invoiced in dollars. Slovakia data for 2002.

Average Annual change in Euro and Dollar shares in Invoicing 2000-2002



Source: Author's calculations using data from the ECB report and local country sources (details in paper)

Czech Republic and Bulgaria started with lower than “expected” dollar use.