Comment on 'International Prices and Productivity: an Empirical Analysis of the Transmission among OECD Countries'

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Comment

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Introduction

What are the effects of technology shocks on the exchange rate, the trade balance, and on domestic and foreign real activity? The Corsetti, Dedola, and Leduc (CDL) chapter is the first paper (to my knowledge) that addresses this empirical question using Vector Autoregression (VAR) techniques. The paper thus fills an important gap in the literature.[1]

CDL use quarterly post-Bretton Woods data for the United States, Japan, Germany, United Kingdom, and Italy. They focus on shocks that improve the technology of a country's manufacturing sector, relative to the technology of foreign (rest of the world, ROW) manufacturing. CDL find that a country-specific positive manufacturing technology shock raises domestic manufacturing output and labor productivity, as well as private consumption (relative to ROW variables), but that it lowers net exports. CDL's baseline VAR model suggests that, in the United Kingdom and Italy, a positive technology shock triggers a real exchange rate (RER) *depreciation;* in the United States and Japan, by contrast, a positive technology shock triggers a RER *appreciation*. CDL consider three measures of the RER, namely measures based on consumer price indices (CPIs), on manufacturing producer price indices (PPIs), and on export prices. For a given country, the reported responses of the three RER measures are qualitatively similar.

The estimated responses of output, consumption, and net exports are consistent with standard economic theory. For example, the increase in (relative) consumption can be rationalized by models with limited international risk sharing and/or consumption home bias (Kollmann 1996, 2001).

Intuitively, an exogenous increase in a country's supply of manufactured goods is expected to lower the relative price of those goods.

Hence, CDL's finding that (in the United States and Japan) a positive manufacturing technology shock triggers a *rise* of the relative price of domestic manufactured goods compared to foreign manufactured goods (appreciation of the RER measures based on manufacturing PPIs and on export prices) challenges conventional wisdom. By contrast, standard theory is consistent with the idea that a positive tradable good (manufacturing) supply shock may appreciate the CPI based RER, due to an increase in the relative price of domestic non-tradables (Balassa-Samuelson effect).

Robustness of Results

In what follows, the robustness of CDL's results will be investigated. I use the same econometric method as CDL, but consider *annual* data for a larger set of thirteen OECD countries (see table 3C2.1).[2] The sample period is 1973–2003. A VAR in first differenced variables is separately fitted to each country (see CDL's equation (2)).[3] In the baseline specification used here, the vector of first differenced variables used for the country *j* VAR is:

$$Z^k_{j,t} \equiv [\Delta \ln x_{j,t}, \Delta \ln Y_{j,t}, \Delta \ln C_{j,t}, \Delta NX_{j,t}, \Delta \ln RER^k_{j,t}],$$

where $x_{j,t}$, $Y_{j,t}$, and $C_{j,t}$, are manufacturing output per hour worked, manufacturing output, and private consumption in country *j*, (respectively) expressed as ratios of corresponding ROW aggregates; $NX_{j,t}$ is *j*'s net export divided by *j*'s GDP; $RER^k_{j,t}$ (with $k = C, X$) is *j*'s real exchange rate (vis-à-vis ROW); and a rise in $RER^k_{j,t}$ represents an appreciation. I consider two real exchange rate measures: a CPI based measure ($RER^C_{j,t}$), and a measure based on export prices ($RER^X_{j,t}$).[4] Note that the baseline specification here includes the same variables as CDL's VAR—with the following exceptions: no PPI/CPI ratios and no PPI-based RER measures are used here, due to gaps in the PPI series (for several countries). The results below are based on VARs of order one.[5] The data are described in the Appendix.

For each country, the tables below report median responses to a positive one standard deviation country-specific innovation to manufacturing technology. The median responses are based on one thousand draws from the posterior distribution of the VAR parameters, obtained using CDL's Bayesian approach. For each variable, the posterior probability is also shown that the response of that variable is positive (see figures in parentheses).

Table 3C2.1
Baseline VAR Model: Dynamic Responses to Exogenous Technology Shock (in %)

	Country												
	US	CA	AU	JP	BE	DK	FR	DE	IT	NL	NO	SE	UK
Impact responses													
x	**1.12**	**1.53**	**1.24**	**2.30**	**1.86**	**2.78**	**1.43**	**0.82**	**2.70**	**1.58**	**1.69**	**2.45**	**1.35**
	(.97)	*(.99)*	*(.99)*	*(.99)*	*(.99)*	*(.99)*	*(.99)*	*(.95)*	*(.95)*	*(.99)*	*(.99)*	*(.99)*	*(.99)*
Y	–0.76	–0.05	–0.13	**2.45**	**0.63**	**1.21**	**1.04**	0.26	**1.64**	0.01	0.48	**1.99**	–0.40
	(.20)	*(.44)*	*(.48)*	*(.94)*	*(.98)*	*(.85)*	*(.99)*	*(.72)*	*(.94)*	*(.56)*	*(.63)*	*(.97)*	*(.26)*
C	0.21	0.01	0.20	**1.01**	**–0.66**	0.31	**0.52**	0.00	**0.86**	–0.63	–0.61	–0.15	0.23
	(.65)	*(.55)*	*(.66)*	*(.93)*	*(.10)*	*(.62)*	*(.89)*	*(.52)*	*(.87)*	*(.17)*	*(.19)*	*(.41)*	*(.62)*
NX	0.05	0.23	**0.44**	–0.13	0.25	0.05	–0.19	**0.49**	–0.26	**0.59**	–0.87	**0.35**	–0.14
	(.68)	*(.72)*	*(.90)*	*(.25)*	*(.82)*	*(.58)*	*(.19)*	*(.90)*	*(.24)*	*(.86)*	*(.21)*	*(.89)*	*(.31)*
RER^C	0.62	**2.09**	**5.00**	–1.37	**–1.58**	**–1.49**	**–1.52**	1.37	**–3.41**	0.30	0.31	–1.70	**3.07**
	(.59)	*(.93)*	*(.97)*	*(.34)*	*(.13)*	*(.09)*	*(.09)*	*(.83)*	*(.08)*	*(.60)*	*(.59)*	*(.19)*	*(.93)*
RER^X	0.68	1.03	**1.60**	–0.03	**–0.89**	**–1.20**	**–1.81**	–0.56	**–2.44**	–0.47	**–3.72**	–0.99	–0.20
	(.66)	*(.81)*	*(.89)*	*(.49)*	*(.08)*	*(.09)*	*(.07)*	*(.28)*	*(.04)*	*(.25)*	*(.09)*	*(.22)*	*(.44)*
Responses 2 years after shock													
x	**2.96**	**2.94**	**1.82**	**2.79**	**3.46**	**2.97**	**2.05**	**1.19**	**3.98**	**2.72**	**2.26**	**4.52**	**3.85**
	(.99)	*(.99)*	*(.99)*	*(.99)*	*(.99)*	*(.99)*	*(.99)*	*(.99)*	*(.94)*	*(.99)*	*(.99)*	*(.99)*	*(.99)*
Y	0.26	–0.06	–0.32	**3.72**	**1.56**	0.97	**1.67**	0.37	**3.69**	0.39	0.32	**5.99**	0.73
	(.56)	*(.45)*	*(.44)*	*(.95)*	*(.98)*	*(.73)*	*(.99)*	*(.65)*	*(.94)*	*(.82)*	*(.51)*	*(.99)*	*(.68)*
C	**1.61**	–0.44	**1.18**	**2.19**	–0.60	0.37	0.40	1.08	**1.88**	0.21	–1.06	0.71	0.49
	(.96)	*(.36)*	*(.89)*	*(.96)*	*(.23)*	*(.61)*	*(.70)*	*(.73)*	*(.89)*	*(.57)*	*(.19)*	*(.72)*	*(.66)*
NX	–0.19	0.36	0.25	–0.30	0.33	–0.12	–0.07	0.54	–0.07	**1.01**	–0.35	**0.57**	–0.49
	(.24)	*(.72)*	*(.69)*	*(.19)*	*(.74)*	*(.42)*	*(.43)*	*(.81)*	*(.45)*	*(.88)*	*(.46)*	*(.89)*	*(.18)*

RER^C	1.32	−1.44	2.56	−1.33	**−2.33**	−0.75	**−3.13**	**3.20**	−2.65	−0.20	0.92	0.56	−1.34
	(.62)	(.22)	(.79)	(.39)	(.14)	(.27)	(.02)	(.95)	(.22)	(.46)	(.71)	(.62)	(.35)
RER^X	0.93	−0.67	0.50	−1.08	**−2.00**	**−1.56**	**−2.50**	0.55	**−2.59**	0.38	−2.79	−0.37	−1.45
	(.62)	(.36)	(.60)	(.32)	(.02)	(.07)	(.06)	(.65)	(.07)	(.66)	(.26)	(.42)	(.26)
Responses 10 years after shock													
x	**3.72**	**2.64**	**1.88**	**2.98**	4.09	3.17	**2.10**	**1.45**	4.68	**2.79**	**2.30**	**3.89**	**4.44**
	(.99)	(.99)	(.99)	(.99)	(.99)	(.99)	(.99)	(.99)	(.95)	(.99)	(.99)	(.99)	(.99)
Y	0.90	0.14	−0.31	**4.03**	**1.73**	0.91	**1.58**	0.27	**5.40**	0.37	0.24	**5.63**	**2.09**
	(.73)	(.54)	(.42)	(.94)	(.98)	(.69)	(.98)	(.58)	(.94)	(.80)	(.51)	(.99)	(.93)
C	**2.44**	−0.41	**1.12**	**2.37**	−0.56	0.37	0.32	1.22	**3.04**	0.24	−1.10	1.02	1.02
	(.97)	(.39)	(.86)	(.95)	(.28)	(.58)	(.65)	(.75)	(.90)	(.58)	(.19)	(.80)	(.77)
NX	−0.38	0.38	0.26	−0.33	0.35	−0.15	−0.08	0.55	−0.12	**1.04**	−0.32	**0.47**	**−0.87**
	(.13)	(.74)	(.70)	(.22)	(.70)	(.40)	(.43)	(.79)	(.43)	(.89)	(.49)	(.84)	(.09)
RER^C	0.20	−1.33	1.84	−1.40	**−2.62**	−0.59	**−3.12**	**3.56**	−2.68	−0.24	0.95	0.94	−2.05
	(.51)	(.25)	(.75)	(.41)	(.15)	(.35)	(.02)	(.95)	(.26)	(.44)	(.71)	(.68)	(.26)
RER^X	−0.01	−0.97	0.13	−0.98	**−2.34**	**−1.58**	**−2.45**	0.40	**−2.24**	0.30	−2.62	0.54	−2.14
	(.49)	(.32)	(.54)	(.34)	(.02)	(.06)	(.06)	(.61)	(.13)	(.63)	(.31)	(.72)	(.20)

Notes: The columns labeled US, CA, etc. show responses of different countries to a one standard deviation country-specific innovation to manufacturing technology. CA: Canada; AU: Australia; JP: Japan; BE: Belgium; DK: Denmark; FR: France; DE: Germany; IT: Italy; NL: Netherlands; NO: Norway; SE: Sweden.

The rows labeled *x*, *Y*, etc. show responses of the corresponding variables. *x*: a country's manufacturing labor productivity (relative to manufacturing productivity in the rest of the world, ROW); *Y*: manufacturing output (relative to ROW manufacturing output); *C*: consumption (relative to ROW consumption); *NX*: net exports (normalized by GDP); *RER*^{C}: CPI based real exchange rate; *RER*^{X}: real exchange rate based on export prices. Responses of *x*, *Y*, *C*, *RER*^{C}, and *RER*^{X} are expressed as percentage deviations from an unshocked path. Responses of *NX* are expressed as differences from the unshocked path.

The table reports median responses based on the posterior distribution of VAR parameters. Figures in parentheses: posterior probability that response is positive. **Bold font**: responses for which the interval between the 16th and 84th percentiles of the posterior distribution does not include zero.

Table 3C2.2
Alternative VAR Models: Responses to Exogenous Technology Shock (in %)

	Country												
	US	CA	AU	JP	BE	DK	FR	DE	IT	NL	NO	SE	UK
	(a) Bivariate VAR: labor productivity and real exchange rate												
Impact responses													
RER^C	–0.73	0.13	–0.51	**–3.48**	**–2.13**	**–1.58**	**–2.19**	–0.85	**–2.51**	0.36	–0.02	**–2.76**	–0.14
	(.39)	*(.51)*	*(.42)*	*(.10)*	*(.03)*	*(.03)*	*(.01)*	*(.28)*	*(.07)*	*(.60)*	*(.49)*	*(.05)*	*(.47)*
RER^X	–0.13	0.67	0.37	–0.98	**–1.07**	**–1.79**	**–2.03**	**–1.41**	**–2.25**	0.26	–0.53	**–2.07**	–1.25
	(.47)	*(.73)*	*(.60)*	*(.25)*	*(.02)*	*(.00)*	*(.03)*	*(.14)*	*(.01)*	*(.61)*	*(.42)*	*(.05)*	*(.19)*
Responses 2 years after shock													
RER^C	–0.07	**–4.30**	–0.90	**–3.90**	**–2.64**	–0.79	**–3.25**	0.66	–0.83	–0.06	0.36	–0.47	**–3.68**
	(.48)	*(.01)*	*(.38)*	*(.13)*	*(.05)*	*(.19)*	*(.00)*	*(.68)*	*(.35)*	*(.48)*	*(.63)*	*(.40)*	*(.06)*
RER^X	–0.72	–1.39	–0.19	**–2.39**	**–2.11**	**–1.82**	**–2.35**	–0.42	**–2.11**	0.68	–0.02	–1.37	**–2.54**
	(.39)	*(.17)*	*(.46)*	*(.11)*	*(.01)*	*(.02)*	*(.02)*	*(.39)*	*(.04)*	*(.77)*	*(.49)*	*(.23)*	*(.08)*
Responses 10 years after shock													
RER^C	0.17	**–3.90**	–0.87	**–3.86**	**–2.68**	–0.56	**–3.52**	0.81	–0.68	–0.10	0.51	–0.46	**–5.45**
	(.52)	*(.02)*	*(.37)*	*(.13)*	*(.07)*	*(.24)*	*(.00)*	*(.70)*	*(.38)*	*(.47)*	*(.66)*	*(.42)*	*(.04)*
RER^X	–0.84	**–1.66**	–0.19	**–2.39**	**–2.50**	**–1.82**	**–2.42**	–0.41	**–2.14**	0.67	–0.03	–1.12	**–3.36**
	(.39)	*(.14)*	*(.46)*	*(.11)*	*(.01)*	*(.02)*	*(.02)*	*(.39)*	*(.03)*	*(.77)*	*(.49)*	*(.27)*	*(.08)*

(b) Five variable VAR: labor productivity, output, CPI, government purchases, RER

Impact responses													
RER^C	–0.83	**2.21**	1.27	–2.44	0.15	–0.35	**–1.58**	–0.24	**–2.29**	0.58	–0.83	–1.17	**2.63**
	(.34)	*(.96)*	*(.68)*	*(.23)*	*(.57)*	*(.36)*	*(.11)*	*(.46)*	*(.12)*	*(.70)*	*(.28)*	*(.24)*	*(.89)*
RER^X	0.25	1.13	–0.06	0.01	–0.10	–0.44	**–1.57**	–0.01	**–1.71**	–0.58	–1.98	–0.38	–0.91
	(.59)	*(.82)*	*(.48)*	*(.51)*	*(.40)*	*(.30)*	*(.11)*	*(.49)*	*(.15)*	*(.31)*	*(.28)*	*(.35)*	*(.26)*
Responses 2 years after shock													
RER^C	–2.69	–1.42	–1.64	–2.32	–1.03	–0.28	**–2.68**	1.39	–2.01	0.06	0.56	0.57	–1.30
	(.26)	*(.26)*	*(.31)*	*(.31)*	*(.26)*	*(.41)*	*(.08)*	*(.75)*	*(.23)*	*(.53)*	*(.62)*	*(.60)*	*(.31)*
RER^X	–1.79	–0.58	–1.86	–1.62	**–1.39**	**–1.14**	**–2.14**	0.94	–1.64	0.16	–3.61	–0.62	**–1.77**
	(.20)	*(.37)*	*(.25)*	*(.29)*	*(.03)*	*(.14)*	*(.11)*	*(.67)*	*(.19)*	*(.56)*	*(.24)*	*(.39)*	*(.23)*
Responses 10 years after shock													
RER^C	–2.91	–1.58	–2.73	–1.51	–1.61	–0.38	**–3.30**	**2.24**	–0.23	–1.19	0.98	0.88	–2.61
	(.33)	*(.25)*	*(.23)*	*(.38)*	*(.17)*	*(.39)*	*(.09)*	*(.86)*	*(.48)*	*(.28)*	*(.68)*	*(.66)*	*(.17)*
RER^X	–2.32	–0.85	**–2.67**	–1.98	**–1.79**	**–1.29**	**–2.61**	0.98	–3.03	0.00	**–2.91**	0.49	–2.49
	(.20)	(.33)	(.20)	(.26)	(.01)	(.11)	(.13)	(.66)	(.18)	(.51)	(.31)	(.60)	(.19)

Notes: The table reports median responses based on the posterior distribution of VAR parameters. Figures in parentheses: posterior probability that response is positive. **Bold font:** responses for which the interval between the 16th and 84th percentiles of the posterior distribution does not include zero. See table 2 for additional explanations.

Table 3C2.1 reports results for the baseline VAR. Due to space constraints, only impact responses, as well as responses two and ten years after the shock, are reported. In all thirteen countries, a positive country-specific manufacturing technology shock triggers a positive (median) response of manufacturing labor productivity (relative to ROW productivity). On impact, the (median) response of manufacturing output is positive in nine of the thirteen countries; ten years after the shock, twelve countries exhibit a (median) rise in relative output. Relative consumption exhibits a positive (median) response in ten countries, although consumption increases are mostly less significant than output increases. The output and consumption responses in table 3C2.1 are, thus, qualitatively consistent with those reported by CDL.

For three of the five countries considered by CDL, table 3C2.1 reports a (median) fall of net exports, in response to a positive technology shock which is likewise consistent with CDL. However, for the *other* countries in the present sample of thirteen countries, net exports tend to *rise*. Overall, the (median) response of net exports is negative in only about half of the thirteen countries.

On impact, a positive manufacturing technology shocks triggers a (median) *depreciation* of the CPI based RER (RER^C), in six of the thirteen countries; two and ten years after the shock, a (median) RER^C *depreciation* is reported for eight countries. On impact, the export-prices-based RER (RER^X) shows a (median) *depreciation* in ten countries; two and ten years after the shock, a (median) RER^X *depreciation* occurs in nine countries. It has to be noted that the variance of the posterior distribution of the RER^C and RER^X responses is often high.

Table 3C2.2 reports results for alternative VAR models. Panel (a) considers bivariate VARs in first differences of (relative) productivity and of the RER: $Z^k_{j,t} \equiv [\Delta \ln x_{j,t}, \Delta \ln RER^k_{j,t}]$. The bivariate VARs suggest that a positive technology shock generates (median) RER^C and RER^X *depreciations*, in ten or more of the thirteen countries (on impact), as well as two and ten years after the shock. In all countries, labor productivity responds positively to the shock (not shown in table 3C2.2).

CDL study a VAR model that only comprises real variables. Panel (b) of table 3C2.2 considers a five-variable VAR that includes a country's CPI inflation differential vis-à-vis the ROW ($\Delta \ln CPI_{j,t}$), i.e. an indicator of the country's (relative) monetary policy stance. The VAR also includes a fiscal policy measure: the log growth rate of relative (real) government purchases ($G_{j,t}$), specifically the vector of variables used for country j is $Z^k_{j,t} \equiv [\Delta \ln x_{j,t}, \Delta \ln Y_{j,t}, \Delta \ln CPI_{j,t}, \Delta \ln G_{j,t}, \Delta \ln RER^k_{j,t}]$. It appears that a positive country-specific manufacturing technology shock raises (relative) government purchases, and that it lowers the (relative) CPI in eight of the countries (not shown in the table). Panel (b) shows that, on impact, the shock induces a (median) RER^C *depreciation* in eight countries, and a (median) RER^X *depreciation* in ten countries; ten years after the shock, RER^C and RER^X both show (median) *depreciations* in ten countries.

Under the VAR specification in table 3C2.1, the evidence that a positive technology shock triggers a RER depreciation is strongest for the European countries. By contrast, Table 3C2.2 suggests a RER *depreciation*, for both European and non-European countries. Note especially that table 3C2.1 suggests that a U.S. technology shock triggers a U.S. RER *appreciation*—consistent with CDL's findings. However, table 3C2.2 seems more suggestive of a U.S. RER *depreciation*; eg, under the five-variable VAR in panel (b) of table 3C2.2, the posterior probability that a RER^X depreciation occurs two years and ten years after a positive U.S. productivity shock is 80 percent. It also seems noteworthy that, by contrast to CDL, *all* specifications here suggest that (in Japan) a country specific technology shock induces a RER *depreciation*.

Summary

The results here support the finding that a positive country-specific technology shock raises a country's labor productivity, output, and private consumption (relative to rest of the world aggregates). For the larger sample of thirteen countries here, there is less evidence (than in the sample used by Corsetti, Dedola, and Leduc) that a positive technology shocks triggers a fall of net exports. Most importantly, the results here seem more consistent—than those of CDL—with the view that a positive country-specific technology shock induces a real exchange rate depreciation; this holds especially for the export-prices-based real exchange rate. Overall, the evidence here supports the conventional view that an exogenous increase in a country's supply of traded goods *worsens* its terms of trade.

Data Sources

The data on manufacturing output, and on manufacturing labor productivity (per hour worked) were downloaded from the U.S. Bureau of Labor Statistics website. The remaining data were taken from the IMF's International Financial Statistics database. "Rest of the world" (ROW) productivity, output and consumption, from country *j*'s viewpoint, are weighted geometric averages of variables of the remaining twelve countries included in the sample. Country *j*'s real exchange rate (RER) is a trade-weighted geometric average of bilateral RERs between *j* and the remaining countries in the sample. Trade weights computed by the Bank of International Settlements (downloaded from the BIS web site) were used. The BIS weighting matrix is based on trade data for the period 1990–92; it includes a larger number of countries than the study here. The countries that are not included here were dropped from the weighting matrix, and the matrix was normalized to ensure that weights sum to unity.

Notes

1. Several recent papers have used VARs to estimate the effect of technology shocks, on domestic variables (Galì 1999; Dedola and Neri 2004).

2. No quarterly series for the measure of manufacturing labor productivity used here (output per hour worked) seem to exist for the entire set of countries.

3. Augmented Dickey-Fuller tests (not reported due to space constraints) fail to reject the hypothesis that the variables (in levels) follow unit root processes.

4. For each country, I estimate a VAR in $Z^C_{j,t}$, and a VAR in $Z^X_{j,t}$ (NB $Z^C_{j,t}$, [$Z^X_{j,t}$] is the vector of variables that includes the CPI based [export prices based] RER). Responses of $x_{j,t}$, $Y_{j,t}$, $C_{j,t}$ and $NX_{j,t}$ are very similar across those VARs. The responses of $x_{j,t}$, $Y_{j,t}$, $C_{j,t}$, $NX_{j,t}$, $RER^C_{j,t}$, reported below are based on the VAR in $Z^C_{j,t}$; the responses of $RER^X_{j,t}$ are based on the VAR in $Z^X_{j,t}$.

5. I experimented with VARs of order zero, one, two, three, and four. The results do not depend on the order of the VAR.

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