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A PANEL ESTIMATION APPROACH FOR THE EURO AREA

by Bettina Landau
and Frauke Skudelny

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In 2009 all ECB publications feature a motif taken from the €200 banknote.

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Abstract:

In this paper we analyse in a mark-up framework the pass-through of commodity price and exchange rate shocks to the main components of producer and consumer prices. Thereby we link movements in prices at the different production stages as firms set their prices as a mark-up over production costs. The empirical results reveal significant linkages between different price stages in the euro area. The overall results are roughly in line with the literature and provide insight into the effects at different stages of the production chain. Non-energy commodity prices turn out to be important determinants of euro area prices.

Keywords: Pass-through, producer prices, consumer prices, commodity prices, exchange rate

JEL Codes: E31, E37

Non-technical summary

Since the start of Stage III of the European Monetary Union (EMU) in January 1999, the euro area has been subject to a large number of external shocks such as a significant increase in energy prices, substantial fluctuations in its effective exchange rate and, more recently, a strong increase in non-energy commodity prices. Such movements can generally be expected to impact, *inter alia*, significantly on price developments. So far, the literature has covered the impact of exchange rates on headline and core inflation in the euro area or a number of euro area countries (see for example, Gagnon and Ihrig (2004), Choudhri et al. (2002), Choudhri and Hakura (2002), Faruqee (2006), Hahn (2003), Hüfner and Schröder (2002), Campa and González Mínguez (2006), Campa and Goldberg (2006a and b), McCarthy (2000) and Bailliu and Fujii (2004)). The question how euro area prices, foremost consumer prices, react to a change in oil prices has been analysed primarily in the context of macro-econometric models such as the ECB AWM, the Quest Model of the European Commission, OECDs interlink and the NiGEM. Quite a number of recent studies have looked at the possibility of a change in the impact of exchange rates (see for example Bussière and Peltonen (2008), Campa and Goldberg (2006b) and Gagnon and Ihrig (2004)).

Overall, only few studies have analysed a pricing chain, i.e. the transmission of such shocks via production costs to consumer prices (see for example Hahn (2003), Faruqee (2006) and McCarthy (2000), who conduct the analysis within a VAR approach). None of the studies has, to our knowledge, considered the transmission via different sectors in such a pricing chain framework, particularly regarding the difference in the transmission between tradable (goods) and non-tradable (services) prices. Hahn (2007) has analysed the impact of exchange rates on sectoral producer prices without, however, estimating a pricing chain framework.

The purpose of this paper is to analyse in a mark-up framework the pass-through of external shocks (commodity prices, split into energy and non-energy commodities, and the exchange rate) to the main components of the producer price index and the Harmonised Index of Consumer Prices excluding energy and unprocessed food (HICPX). The general idea is to link movements in prices at the different stages of production as, in theory, a firm sets its prices as a mark-up over (marginal) production costs. Consequently, for a given profit margin, an increase in the price of a material input will push costs up, giving a firm an incentive to raise its price. Thus, in general, a natural link between movements of raw material prices and exchange rates, producer prices and consumer prices exists.

The analysis of the pricing chain for producer and consumer prices reveals significant inter-linkages between the different price stages in the euro area, thereby demonstrating that

external shocks, such as increases in commodity prices and exchange rate movements, are passed on sequentially to consumers. These links are generally not captured by macro-econometric models which might be the reason why our small and partial pricing model is still capable of reproducing relatively similar results although spill-over effects, in particular from activity to prices, are not captured. Second, the inclusion of non-energy commodity prices (split into food and industrial raw material commodities) in the analysis reveals that these are rather important determinants of euro area prices but have so far been left out of the analysis in the existing literature. Third, the distinction between goods and services prices gives a more refined view on the determinants of these prices, which may help to better understand their developments.

Our results suggest that a shock to the nominal effective exchange rate of the euro has a direct effect on most HICP components, but also indirect effects via the producer price components. In general, the size and timing of these effects is similar to what has been found in the literature at an aggregate level when taking into account that we have used the HICP excluding unprocessed food and energy in our estimations. Meanwhile, energy and food commodity and industrial raw material price shocks have a direct effect on producer prices and are passed through indirectly, via these components, to consumer prices, except for food commodity prices which also have a direct impact on processed food consumer prices. The estimation results are consistent with the shares of imports of each sector by its output as measured in input-output tables. An analysis of bootstrapped confidence intervals shows that for most simulations, the confidence bands are relatively narrow in most cases and suggest that the pricing chain is working in the expected way.

1. Introduction

Since the start of Stage III of the European Monetary Union (EMU) in January 1999, the euro area has been subject to a large number of external shocks such as a significant increase in oil prices, substantial fluctuations in its effective exchange rate and, more recently, a strong increase in non-energy commodity prices. Such movements can generally be expected to impact, *inter alia*, significantly on price developments. So far, the literature has covered the impact of exchange rates on headline and core inflation in the euro area or a number of euro area countries (see for example, Gagnon and Ihrig (2004), Choudhri et al. (2002), Choudhri and Hakura, (2002), Faruqee (2006), Hahn (2003), Hüfner and Schröder (2002), Campa and González Mínguez (2006), Campa and Goldberg (2006a and b), McCarthy (2000) and Bailliu and Fujii (2004). The question how euro area prices, foremost consumer prices, react to a change in energy prices has been analysed primarily in the context of macro-econometric models such as the ECB AWM, the Quest Model of the European Commission, OECDs interlink and the NiGEM, using however oil rather than overall energy prices. Quite a number of recent studies have looked at the possibility of a change in the impact of exchange rates (see for example Bussière and Peltonen (2008), Campa and Goldberg (2006b) and Gagnon and Ihrig (2004)). Overall, only few studies have analysed a pricing chain, i.e. the transmission of such shocks via production costs to consumer prices (see for example Hahn (2003), Faruqee (2006) and McCarthy (2000)[2], who conduct the analysis within a VAR approach). None of the studies has, to our knowledge, considered the transmission via different sectors in such a pricing chain framework, particularly regarding the difference in the transmission between tradable (goods) and non-tradable (services) prices. Hahn (2007) has analysed the impact of exchange rates on sectoral producer prices without, however, estimating a pricing chain framework.

The purpose of this paper is to analyse in a mark-up framework the pass-through of external shocks (commodity prices, split into energy and non-energy commodities, and exchange rates) to the main components of the producer price index (PPI) and the Harmonised Index of Consumer Prices excluding energy and unprocessed food (HICPX). The general idea is to link movements in prices at the different stages in production as, in theory, a firm sets its prices as a mark-up over (marginal) production costs. Consequently, for a given profit margin, an increase in the price of a material input will push costs up, giving a firm an

---

[2] Note that McCarthy (2000) finds only a modest effect of exchange rates, while import prices have a stronger effect. For most countries in his analysis, he finds non-significant results.

incentive to raise its price. Thus, in general, a natural link between movements of raw material prices and exchange rates, producer prices and consumer prices exists. Hence, the basic set-up should reflect the pricing chain according to the causalities as shown in Table 1.

Table 1 Possible causalities between price variables

		Endogenous variables					
		PPI_ENE	PPI_INT	PPI_CONS	HICP_FDPR	HICP_NEIG	HICP_SERV
Exogenous variables	NEER	x	x	x	x	x	x
	COMENE	x	x	x	x	x	x
	COMFD	x	x	x	x	x	x
	COMIRM	x	x	x	x	x	x
	VAT				x	x	x
	ULC	x	x	x	x	x	x
	YGAP	x	x	x	x	x	x
	EXTRA_OPEN	x	x	x	x	x	x
	ENETAX	x	x	x	x	x	x
Endogenous variables	PPI_ENE	x	x	x	x	x	x
	PPI_INT		x	x	x	x	x
	PPI_CONS			x	x	x	x
	HICP_FDPR				x		
	HICP_NEIG					x	
	HICP_SERV						x

NEER: nominal effective exchange rate of the euro; COMENE: energy commodity prices in USD; COMFD: food commodity prices in USD; COMIRM: industrial raw material prices in USD; VAT: value added tax; ULC: unit labour costs; YGAP: output gap; EXTRA_OPEN: extra-euro area trade openness; ENETAX: energy taxes; PPI_ENE: PPI energy; PPI_INT: PPI intermediate goods; PPI_CONS: PPI consumer goods; HICP_FDPR: HICP processed food; HICP_NEIG: HICP non-energy industrial goods; HICP_SERV: HICP services.

For all endogenous variables (PPI and HICPX components, columns in Table 1), production costs are represented by exchange rates, commodity prices and unit labour costs (exogenous variables, rows 1-9 in Table 1).[3] To reflect the idea of a pricing chain, sectoral prices at earlier stages of the production chain are also recursively included in the production costs of sectoral prices at later stages. This means that PPI energy is explained only by the exogenous variables (and its own lags), while, in addition to the exogenous variables,

- PPI intermediate goods is explained by PPI energy;
- PPI consumer goods is explained by PPI energy and PPI intermediate goods;
- HICPX components, i.e. processed food, non-energy industrial goods, services, are explained by PPI energy, PPI intermediate goods and PPI consumer goods. However, linkages between the components of the HICPX are not considered. The model does not make a difference between the determination of consumer goods and services prices from the outset but let rather the data decide.

[3] Moreover, we have included the output gap (as a proxy for changes in domestic demand conditions) to allow for a flexible mark-up. Given the importance of indirect taxes on price developments, we also include VAT and energy taxes in the mark-up equation.

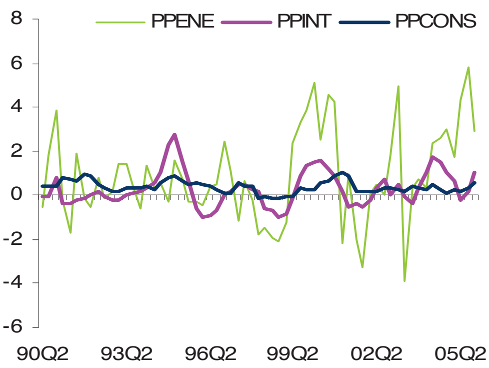
As we want to concentrate on the pass-through to consumer prices, we do not analyse PPI capital goods. Moreover, as the above structure already implies a significant amount of cross-component relationships, we decided not to include sectoral import prices in the model. We include commodity prices separately by splitting them into energy, food and industrial raw material prices as we expect energy prices to have a different impact than non-energy commodity prices. In addition, energy prices might have more importance for particular components of the PPI or the HICPX, while food and industrial raw material prices might be more relevant for other components. This differentiation between energy and non-energy commodity prices is also rather new in the literature.[4]

2. Data and estimation technique

The main variables under consideration are producer prices and consumer prices of the euro area. Chart 1 and Chart 2 show the development in the main components of the PPI (energy, intermediate goods and consumer goods) and the HICPX (HICP excluding unprocessed food and energy and its components).

Chart 1 Producer prices

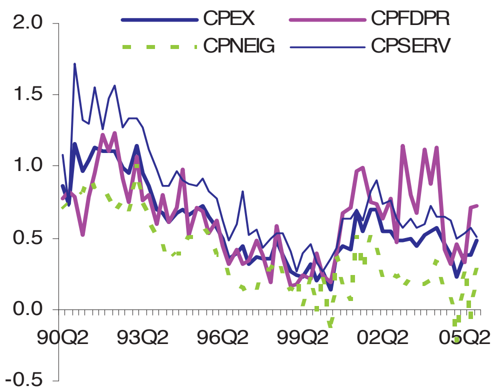
(Quarterly rates of change)



Source: Eurostat.
PPENE: PPI energy; PPINT: PPI intermediate goods; PPCONS: PPI consumer goods.

Chart 2 Consumer prices

(Quarterly rates of change)



Source: Eurostat.
CPFDPR: HICP processed food; CPNEIG: HICP non-energy industrial goods; CPSERV: HICP services, CPEX: HICP excluding unprocessed food and energy, i.e. the weighted average of the three components above using HICP weights.

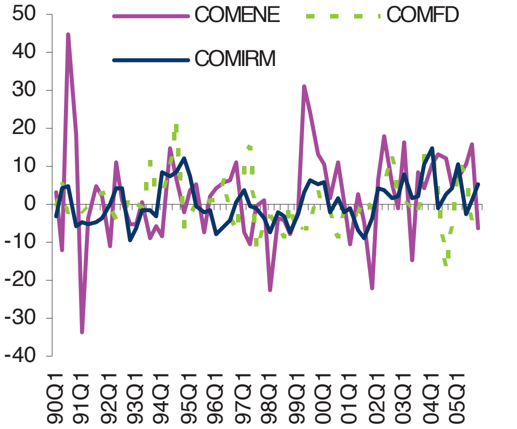
It is clearly visible from these charts that inflation, particularly at the consumer level, decreased significantly in the run-up to EMU but that inflation has since then been affected by

[4] In the Area Wide Model of the ECB, overall commodity prices are used to determine developments in import prices by using a weighted average of oil and non-energy commodity prices. See Fagan et al. (2005).

a number of upward shocks. One of these shocks, the rise in energy (foremost oil) prices, clearly led to higher but also more volatile rates of change in PPI energy prices, with its subsequent impact on non-energy producer and consumer prices. In more recent years, this has been amplified by increases in commodity prices (Chart 3), particularly metal which is part of industrial raw material prices, as a result of high global demand, while the euro also experienced significant fluctuations (Chart 4).

Chart 3 Commodity prices

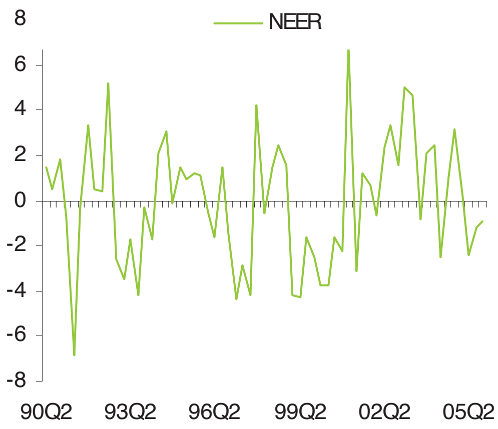
(Quarterly rates of change; contributions)



Source: HWWI.
COMENE: energy commodity prices; COMIRM: industrial raw material prices; COMFD: food commodity prices, all in USD.

Chart 4 Nominal effective exchange rate

(Quarterly rates of change; contributions)



Source: ECB.
NEER: nominal effective exchange rate of the euro.

We use panel estimation techniques, employing data for 10 euro area countries (Austria, Belgium, Germany, Spain, France, Greece, Italy, Luxembourg, the Netherlands and Portugal) for the cross-sectional dimension.[5] As this covers more than 95% of the euro area, it allows deriving pass-through coefficients for the euro area as a whole. The panel estimation helps to improve the efficiency of the parameter estimation as we have a relatively short sample for most series and we use a large number of regressors in our estimations. For example, the HICPX components generally start around 1990 and for several countries the availability of sectoral PPI data is also rather limited. We use quarterly data which generally deliver more robust results. Data are seasonally adjusted on the basis of the ARIMA-X12 procedure. We checked the dynamics of our equations and in particular the sum of the coefficients estimated

[5] Appendix I describes the data sources and gives an overview of the data availability. Due to data shortages, we had to exclude Ireland and Finland from the euro area 12 panel. Although French PPI consumer goods data are available only from 1999 onwards, we have extended the data backwards using non-durable and durable PPI up to 1995, and backcasting up to 1980 using PPI and PPI durable goods.

for the lagged dependent variables in order to ensure stationarity. A co-integration analysis has not been considered due to the short sample and due to the fact that the panel is unbalanced. In addition, we have estimated the equations in levels in an AR framework and have checked the AR-coefficient rho in this equation. It turned out to be close to 1 in the equations for PPI consumer goods and for the HICPX components but much lower for the other PPI components. As we want to estimate a pricing chain in a coherent framework, we decided not to exploit the level information from the stationary PPI series (i.e. energy and intermediate goods) and estimate all equations in first differences.

As we want to estimate homogenous coefficients across countries, we also include a variable for trade openness to capture any differences across countries related to the exchange rate pass-through. Trade openness is measured by the ratio of extra-area imports of each country to real GDP. Although this variable should, in the initial equations, be multiplied with the coefficients on the exchange rate variable to capture such heterogeneity, it can be estimated as stand-alone variable (i.e. homogenously across countries) when taking dlogs.[6] This variable does, however, also capture any effect of globalisation so that the expected sign of the coefficient is not clear.

Due to the huge number of variables involved in the above set-up we do not use a panel VAR model but rather estimate single equations. The variables and lags included in the final model for each price variable are selected using a judgemental general to specific approach. That means that we start from a model including most of the exogenous variables and 4 lags for each of the variables and drop progressively variables which are not statistically significant or counter-intuitively signed. However, for the lags of the dependent variables, we keep all lags until the longest significant to avoid too much volatility in the simulations. This procedure is repeated until all variables are significant and correctly signed.

Once the final model specifications have been decided, the impact multiplier of exchange rate and commodity price shocks are calculated in order to assess the pass-through on sectoral prices at the different stages of the production chain. The impact at early stages of the production chain is then used as input to calculate the impact at later stages of the production chain; i.e. the impact multiplier of, say, an energy commodity price shock on PPI intermediate goods is calculated as the direct impact of energy commodity prices on PPI intermediate goods plus the indirect effect of energy commodity prices on PPI intermediate goods via PPI energy, and so on.

---

[6] $P_t = cNEER_t^{\alpha OPEN_t} \Rightarrow \ln(P_t) = \ln(c) + \alpha OPEN_t \ln(NEER_t) \Rightarrow d\ln(P_t) = \alpha \Delta OPEN_t + d\ln(NEER_t)$

3. Estimation results

The equations are estimated with fixed effects.[7] As all equations include lagged dependent variables, the estimators could be biased as the lagged dependent variable is correlated with the fixed effects. It has been proposed in the literature to use the Arellano Bond estimation technique which is based on a GMM estimation of the differenced equation. However, Judson and Owen (1999) have shown that the bias is small when the time dimension is large relative to the cross-sectional dimension. Indeed, they find a negligible bias for a time dimension of 30 or larger. Given that our time dimension is mostly around 50 quarters or more, with some exceptions in Portugal, the Netherlands and Luxemburg (only for energy and intermediate goods producer prices) we do not use the Arellano-Bond estimator.

Despite a significant number of exogenous variables, the estimation of the pass-through should not be affected by strong co-movements between the exogenous variables as there is relatively little contemporaneous correlation among them (see Table 2). No correlation coefficient is above 0.5. The highest correlation exists between energy and food commodity prices (0.41), followed by the correlation between food and industrial raw material commodity prices (0.25). Both correlations could reflect a third driving factor such as global demand and/or the high energy content for food and industrial raw material production.

Table 2 Contemporaneous correlation across exogenous variables

	NEER	COMENE	COMFD	COMIRM	VAT	ULC	YGAP	EXTRA_ OPEN	ENETAX
NEER	**1.00**								
COMENE	-0.05	**1.00**							
COMFD	0.13	0.41	**1.00**						
COMIRM	0.03	-0.03	0.25	**1.00**					
VAT	0.01	-0.08	-0.03	-0.04	**1.00**				
ULC	0.10	-0.07	-0.14	-0.05	0.03	**1.00**			
YGAP	-0.09	0.17	0.24	0.03	-0.05	-0.36	**1.00**		
EXTRA_OPEN	0.00	0.02	0.08	0.04	-0.15	-0.05	-0.05	**1.00**	
ENETAX	-0.05	0.01	0.09	0.10	0.06	-0.03	-0.01	-0.06	**1.00**

NEER: nominal effective exchange rate of the euro; COMENE: energy commodity prices in USD; COMFD: food commodity prices in USD; COMIRM: industrial raw material prices in USD; VAT: value added tax; ULC: unit labour costs; YGAP: output gap; EXTRA_OPEN: extra-euro area trade openness; ENETAX: energy taxes.

Table 3 shows which of the theoretically possible causal relationships (shaded area) in the estimated pricing chain have been found to be significant (the regression results can be found

[7] Random effects estimations yielded similar results.

in Appendix II). The numbers designate the significant lags of each variable. For example, energy commodity prices (COMENE) were significant in the equations of PPI energy (lags 0 to 3) and PPI consumer goods (lag 2), while they have a more indirect effect on all other price components through the pricing chain. This indicates that most imported energy seems to be processed in the euro area before entering the production process of consumer goods. Food commodity prices (COMFD) appear to be relevant for PPI consumer goods and the HICP processed food component, while commodity prices of industrial raw materials have a direct impact only on intermediate goods producer prices. The nominal effective exchange rate (NEER) is significant for all PPI and HICP components except for processed food HICP. The VAT rate is significant for all consumer goods prices. All equations include either the output gap or unit labour costs (or both), with the output gap having apparently a small impact on inflation which is in line with the literature (see for example Musso, Stracca and van Dijk (2009)). Trade openness can affect euro area prices through a number of channels and we therefore do not have a prior belief on the sign of the variable. The variable turns out to be positive and significant in the PPI energy equation, while it is negative and significant for PPI consumer goods, HICP processed food and services. A negative sign could be an indication of a downward impact of globalisation through trade openness on euro area prices. At the same time, the impact on PPI energy could be positive as the entry of emerging markets on the global market tends to lead to higher energy prices, particularly oil, thereby affecting PPI energy positively. Finally, energy taxes are significant only for PPI energy.

Table 3 Selected causalities between price variables

		Endogenous variables					
		PPI_ENE	PPI_INT	PPI_CONS	HICP_FDPR	HICP_NEIG	HICP_SERV
Exogenous variables	NEER	0,2,4	0-1	1		0	0
	COMENE	0-3		2			
	COMFD			0	0,1		
	COMIRM		0-1				
	VAT				0	0,1	0
	ULC	2			0	0,4	0,4
	YGAP		0	4		0	
	EXTRA_OPEN	2		4	0,2		0,1
	ENETAX	1					
Endogenous variables	PPI_ENE	1-4	0,4				
	PPI_INT		1-3	0,4	0,4		
	PPI_CONS			1-4	0,3	0,4	0,4
	HICP_FDPR				1		
	HICP_NEIG					1-2	
	HICP_SERV						1-4

The numbers designate the significant lags of each variable. NEER: nominal effective exchange rate of the euro; COMENE: energy commodity prices in USD; COMFD: food commodity prices in USD; COMIRM: industrial raw material prices in USD; VAT: value added tax; ULC: unit labour costs; YGAP: output gap; EXTRA_OPEN: extra-euro area trade openness; ENETAX: energy taxes; PPI_ENE: PPI energy; PPI_INT: PPI intermediate goods; PPI_CONS: PPI consumer goods; HICP_FDPR: HICP processed food; HICP_NEIG: HICP non-energy industrial goods; HICP_SERV: HICP services.

Regarding own lags, the estimation results are largely consistent with the literature on inflation persistence in the euro area (see e.g. Álvarez et al. (2006)) stemming from the Eurosystems' Inflation Persistence Network (IPN). Table 4 provides an overview over the sum of the coefficients of the lagged dependent variable for each of the endogenous variable. The sum of the coefficients is relatively small for PPI energy, suggesting that there is little persistence in this component and prices change rather frequently. The persistence increases at the later stages of the production, with services inflation having the highest persistence, i.e. the lowest frequency of price changes. However, the estimation results suggest that PPI intermediate goods inflation is of rather similar persistence as HICP non-energy industrial goods inflation, somewhat in contrast to the IPN findings.

Table 4 Sum of lagged dependent variable from the panel estimation

Component	Sum of coeff.	Component	Sum of coeff.
PPI_ENE	0.09	HICP_FDPR	0.28
PPI_INT	0.41	HICP_NEIG	0.42
PPI_CONS	0.15	HICP_SERV	0.57

PPI_ENE: PPI energy; PPI_INT: PPI intermediate goods; PPI_CONS: PPI consumer goods; HICP_FDPR: HICP processed food; HICP_NEIG: HICP non-energy industrial goods; HICP_SERV: HICP services.

We use the results to estimate the impact of shocks on the exogenous variables via the individual price variables. To do so, we estimate the equations and forecast 16 quarters ahead for all price variables, using the forecasted variables from earlier steps in the pricing chain to forecast those later in the pricing chain and assuming no further changes in the exogenous variables except the shocked variable over the forecast horizon. As a result, the effect of the shocked variable is also indirectly transmitted via the pricing chain. As we are mainly interested in the results for the euro area as a whole, we apply the coefficients estimated in the panel of countries directly to euro area data.[8] The resulting impact multipliers for an exchange rate and commodity price change by 1% each are shown in Chart 5 to Chart 9.

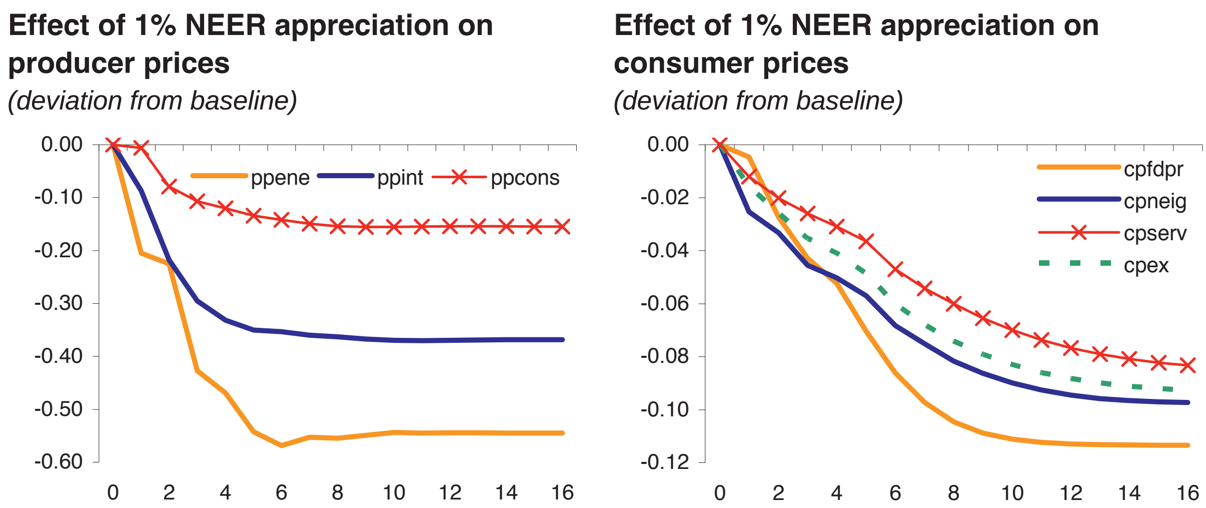
Chart 5 shows the effect of a 1% appreciation of the nominal effective exchange rate on PPI energy (PPENE), PPI intermediate goods (PPINT), PPI consumer goods (PPCONS) and, on the right hand side, on processed food prices (CPFDPR), non-energy industrial goods prices (CPNEIG), and services prices (CPSERV). Moreover, we show the weighted average of the effect on processed food, non-energy industrial goods and services, i.e. the HICP excluding unprocessed food and energy (CPEX). The result is strongest on PPI energy, with an impact

[8] This approach is identical to using the weighted averages of country simulations, as we impose the coefficients to be homogeneous across countries.

of about -0.47% after 4 quarters. It gets progressively weaker following the pricing chain on the PPI, with an effect of -0.35% after 5 quarters on PPI intermediate goods, and of -0.15% after about 8 quarters for PPI consumer goods.

Chart 5 **Impact multiplier of the exchange rate**

(deviation from baseline following 1% increase in nominal effective exchange rate)



PPENE: PPI energy; PPINT: PPI intermediate goods; PPCONS: PPI consumer goods; CPFDPR: HICP processed food; CPNEIG: HICP non-energy industrial goods; CPSERV: HICP services, CPEX: HICP excluding unprocessed food and energy.

The timing and the pass-through to the energy and consumer goods' PPI is similar to Hahn (2007) who found an impact of -0.68 and -0.16 after 8 quarters for these two sectors, respectively, while the effect on PPI intermediate goods is somewhat lower according to her results (-0.17 after 8 quarters). The results of Bailliu and Fujii (2004) are, with a long-run impact of -0.28 to -0.37 on total producer prices, also in line with our results, while Campa and González Mínguez (2006), Faruqee (2006) and Hahn (2003) point to somewhat lower effects on total euro area producer prices (-0.12, -0.17 and -0.06, respectively). Note that the latter four studies also include capital goods in the aggregate which is not taken into account in our study. According to Hahn (2007), the exchange rate pass-through to capital goods consumer prices is around -0.04, i.e. much smaller than what has been found for the other sectors. Choudri et al. (2002) estimated a VAR for the G7 countries excluding the US and found an exchange rate pass-through of -0.15 on producer prices after 10 quarters.

For consumer prices, the effect is rather similar for processed food and non-energy industrial goods prices with an effect around -0.10% after 16 quarters, and a bit smaller for services prices (around -0.08%). The somewhat weaker effect on services prices reflects the lower import content of this component, along with the higher labour intensity of this sector. The pass-through on consumer prices takes longer than for the PPI, with most of the effect coming through after 3 years. The weighted average of the impact multipliers of CPFDPR, CPNEIG and CPSERV (i.e. CPEX) suggests an impact of around -0.09% after 16 quarters.

Simulations with macro-models (NiGEM and the Oxford Economic Forecast) yield an impact of 0.2 on consumer prices from a 1% depreciation of the exchange rate, similar to Campa and Goldberg (2006a), Bailliu and Fujii (2004), Gagnon and Ihrig (2004), Choudhri et al. (2002) and Choudhri and Hakura (2002) who all find a medium- to long-term exchange rate pass-through to consumer prices of 0.2 for euro area or industrialised countries[9]. Meanwhile, the results of Hüfner and Schröder (2002) and Campa and González Mínguez (2006) are substantially lower, with a pass-through of 0.04 and 0.05, respectively. As we estimate the impact on the HICP excluding unprocessed food and energy, our results should be somewhat smaller than what was found in the literature, because the impact of exchange rates via euro-denominated oil prices on the HICP energy is excluded. Indeed, Faruqee (2006) who also estimates the effect of exchange rates on the HICP excluding unprocessed food and energy, finds a pass-through of 0.02 after 18 months, which is somewhat lower than our results.

In addition, it has been argued in the literature that the pass-through of exchange rate changes to consumer prices has become somewhat lower around the 1990s, as central banks increasingly focussed on stabilising prices. This could also explain our somewhat lower estimates as the HICP series start only in the 1990s (which is also true for Faruqee (2006)). For example, Gagnon and Ihrig (2004) find that the long-run pass-through of 20 industrialised countries was on average around 0.16 from 1971 to the mid-80s for an exchange rate depreciation, while it was reduced to 0.05 from the mid-80s to 2003, possibly related to an increased focus on price stability in many central banks. This is also confirmed by Choudri and Hakura (2002) who find a lower exchange rate pass-through for countries with low inflationary environment. In addition, increased competition on foreign markets could also have led to a stronger pricing to the market, reducing thereby the exchange rate pass-through (see also Bussière and Peltonen (2008)). However, as argued by Campa and Goldberg (2006b), the exchange rate pass-through could also have increased due to an expansion of imported inputs used in the production and due to a change in sectoral expenditures on distribution services.

[9] Note that these are the results of Gagnon and Ihrig (2004) for the full sample (1971 to 2003) while they find a lower pass-through when they use the part of the sample where prices were relatively stable. For Choudri and Hakura (2002), the estimates relate to low inflation countries.

Campa and Goldberg (2006) use a different approach to assess exchange rate pass-through for industrialised countries. They use data on *inter alia* imported inputs from input-output tables and distribution margins to calibrate the exchange rate pass-through to consumer prices. They find an exchange rate pass-through of 0.13 to 0.30 for their sample of countries, depending on the assumption regarding the sensitivity of distribution margins to exchange rate variations used in the calibration. The weighted average for the euro area amounts to 0.16 to 0.25; this is somewhat higher than what we find but, again, we only estimate the impact on the HICP excluding unprocessed food and energy.

Taking up the idea of cross-checking results using input-output tables, Table 5 shows for the three PPI components and for total consumer prices the share of imported inputs divided by the total output for each sector (first column).[10] This number is taken from Eurostat input-output tables of 2000, aggregating the tables for Germany, France, Italy, the Netherlands, Austria, Finland and Belgium for the euro area. The second column shows the impact of a 1% exchange rate appreciation after 4 years, according to our estimation results. The share of imported inputs in total output decreases along the production chain, i.e. it is highest (34%) for energy production and lowest for final consumption. This is in line with our estimated impact of the exchange rate pass-through, which is highest for energy producer prices and diminishes along the production chain, with very similar coefficients to the shares in the input-output tables. This might reflect the increasing role of distribution margins, as also suggested in Campa and Goldberg (2006). Note that the total imported inputs do not take into account the indirect effect via imported inputs in other sectors, which would increase these numbers somewhat. Therefore, they cannot be interpreted as an upper range, implying a 100% pass-through.

Table 5 Imported input shares versus estimation results of a 1% NEER appreciation

Total imported inputs / total output		**Estimated impact after 4 years**	
Production of:		Producer prices:	
Energy	0.34	Energy	-0.29
Intermediate goods	0.21	Intermediate goods	-0.18
Consumer goods	0.16	Consumer goods	-0.14
Consumption	0.11	HICPX	-0.08

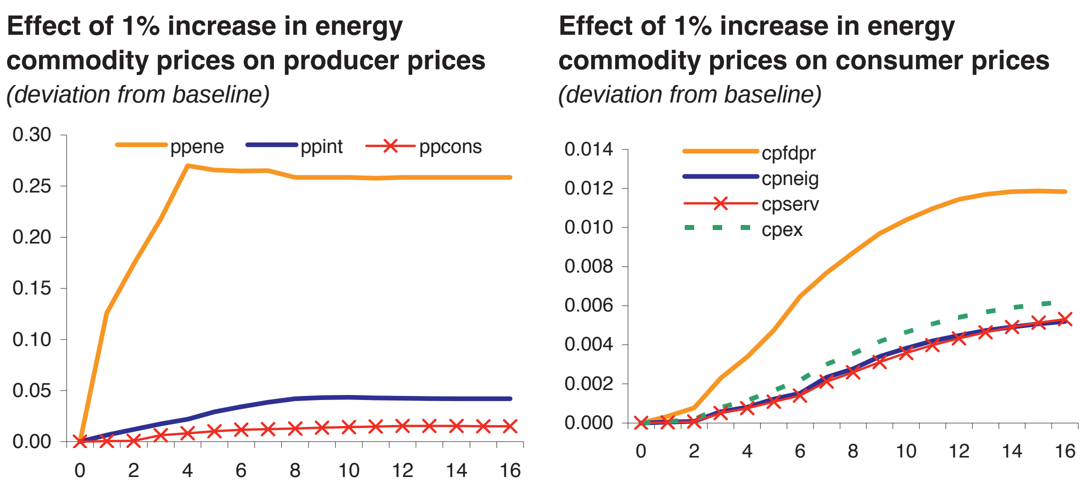
Source: Eurostat and own calculations.

[10] We cannot replicate the results of Campa and Goldberg (2006) because there are no data for mark-ups and imported inputs for the breakdown of components we have used in our study.

Regarding the impact of a 1% increase in energy commodity prices (see Chart 6), except for the direct effect on PPI energy, the effect is rather muted. According to the result, the impact amounts to an increase by 0.27% on PPI energy after 4 quarters, by 0.022% in PPI intermediate and 0.008% in PPI consumer goods. Regarding the impact on consumer prices, the impact is rather similar for non-energy industrial goods and services prices (around 0.005% after 16 quarters), while it is stronger for processed food prices (about 0.012%) , with an overall slower pass-through compared to producer prices. Using the weighted average for the CPEX suggests an impact of 0.006%. It should be noted that the present study only looks into the indirect effect on the non-volatile components of the HICP, while the direct effect on the HICP energy would be significantly stronger and more immediate. A rule of thumb would suggest that a 1% increase in oil prices would lead to a 0.01-0.02% increase in total HICP due to the direct effect of oil prices.[11] A somewhat astonishing fact is that the effect on processed food prices is about twice as large as that on the other consumer prices which is due to a stronger impact of PPI energy and intermediate goods on this component of the HICP. This may reflect the relatively high energy content in food production.

Chart 6 **Impact multiplier of energy commodity prices**

(deviation from baseline following 1% increase in energy commodity prices)



PPENE: PPI energy; PPINT: PPI intermediate goods; PPCONS: PPI consumer goods; CPFDPR: HICP processed food; CPNEIG: HICP non-energy industrial goods; CPSERV: HICP services, CPEX: HICP excluding unprocessed food and energy.

The impact on consumer prices according to our models is roughly in line with that of different macro-models when taking into account the fact that we only consider the HICP excluding unprocessed food and energy here. In particular, the ECB AWM, the EC QUEST,

[11] See European Central Bank (2004).

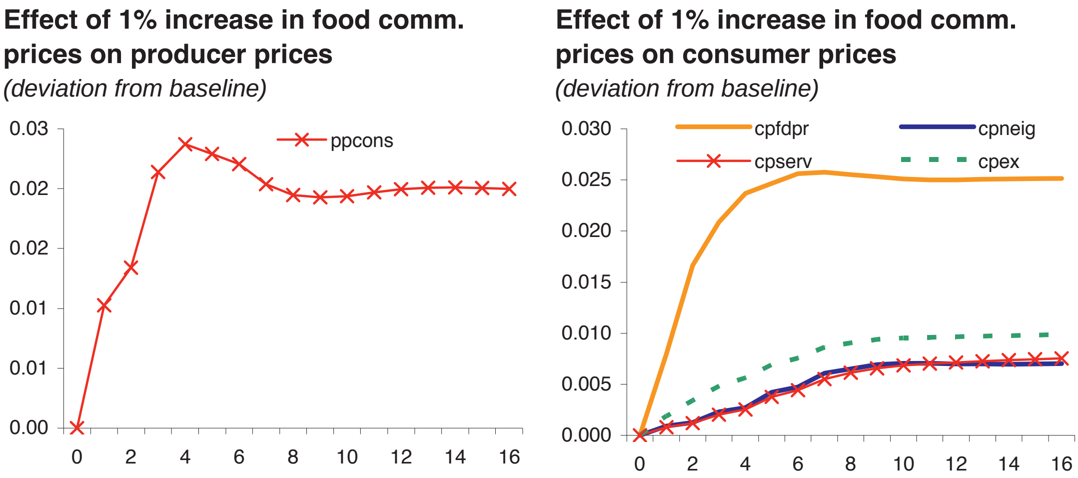
the NiGEM and the OECD Interlink predict a first year impact of a 50% increase in oil prices on consumer prices of 0.3% to 0.6%, and a cumulated 0.5% to 1.0% impact over 3 years.[12] This is significantly higher than the 0.3% we would get for a 50% increase in energy prices on the HICP excluding unprocessed food and energy after 4 years, but roughly in line with our results when allowing for an additional 0.5%-1.0% due to the direct effect of energy on the overall HICP. Looking at the results from small-scale models, Hahn (2003) suggests that a 50% increase in oil prices leads to a 0.9% increase in overall consumer prices after 1 year, 1.6% after 2 years and 2.2% after 3 years, somewhat higher than the results above.

A specificity of our approach is that, unlike other models, we estimate the impact of energy and non-energy commodities separately and we further split the latter into food and industrial raw material prices. This is particularly important in our pricing chain analysis, as different commodity prices might have a different impact on the individual price components.

The results for food commodity prices are shown in Chart 7. The effect is the strongest for PPI consumer goods (around 0.02% after 16 quarters, with most of the impact coming through within the first year), while food commodity prices have, unsurprisingly, not been found to be significant for the other two PPI components.

Chart 7 Impact multiplier of food commodity prices

(deviation from baseline following 1% increase in food commodity prices)



PPENE: PPI energy; PPINT: PPI intermediate goods; PPCONS: PPI consumer goods; CPFDPR: HICP processed food; CPNEIG: HICP non-energy industrial goods; CPSERV: HICP services, CPEX: HICP excluding unprocessed food and energy.

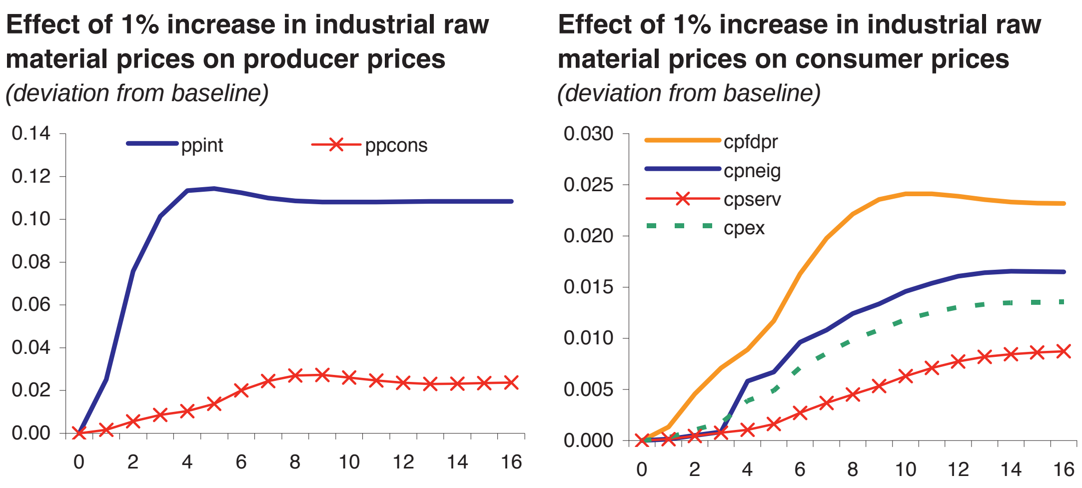
[12] See European Central Bank (2004).

Turning to consumer prices, the effect is strongest for processed food prices, both through a direct impact and through the pricing chain effect from PPI consumer goods. For the other consumer price components, the effect is almost identical and increases progressively to about an impact of less than 0.01% after 8 quarters. Using the weighted average for the CPEX suggests an impact of 0.010% after 16 quarters, which is somewhat larger than the one found for energy commodity prices.

Chart 8 shows the impact multiplier of a 1% increase in industrial raw material prices. As expected, the effect is strongest on intermediate goods PPI (0.11% after 4 quarters), while the effect on the consumer goods PPI is smaller and more gradual (0.03% after 8 quarters) and there is no effect on energy PPI. On the consumer price side, the effect is strongest for processed food (0.023% after 16 quarters), and somewhat smaller for non-energy industrial goods prices (0.016% after 16 quarters) and services (0.009% after 16 quarters). Most of the effect comes through after about 10 quarters, i.e. somewhat slower than for producer prices.

Chart 8 Impact multiplier of industrial raw material prices

(deviation from baseline following 1% increase in raw material prices)



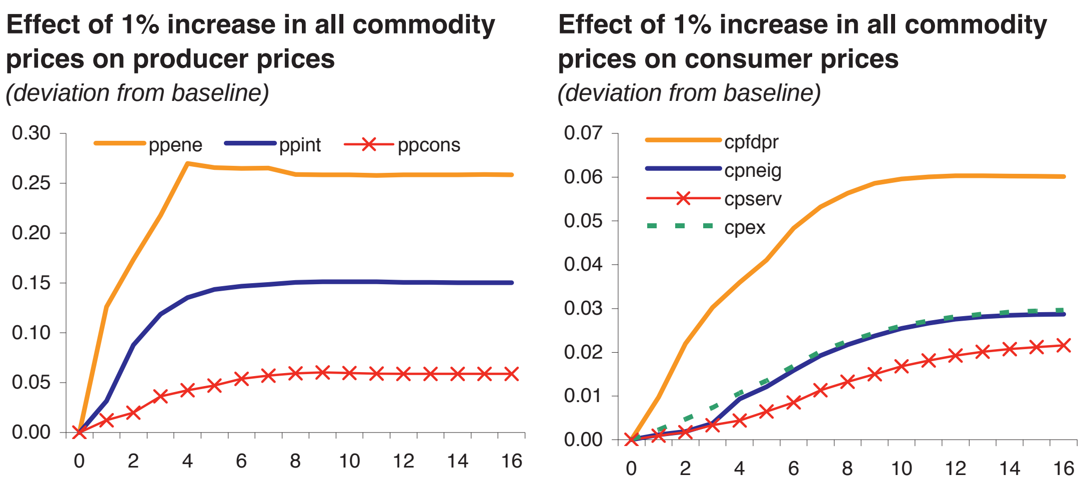
PPENE: PPI energy; PPINT: PPI intermediate goods; PPCONS: PPI consumer goods; CPFDPR: HICP processed food; CPNEIG: HICP non-energy industrial goods; CPSERV: HICP services, CPEX: HICP excluding unprocessed food and energy.

Taking the effects of energy, food and industrial raw material prices together, Chart 9 shows the impact of a 1% increase in all commodity prices simultaneously. This effect is simply obtained by adding up the impact multipliers of the individual commodity prices as shown above. The overall effect on the PPI is strongest for the energy component (0.26% after 16 quarters), followed by the intermediate goods component (0.15% after 16 quarters) where part of the effect comes from the direct effect of industrial raw material prices and part from the indirect effect of energy commodity prices. The effect on consumer goods producer prices is about 0.06% after 16 quarters and stems from direct effects from energy and food commodity prices and indirect effects from energy commodity prices via energy producer prices and from industrial raw material prices via intermediate goods producer prices. The effect on consumer prices is strongest for the component processed food (0.06% after 16 quarters), due to the relatively strong effect of food commodity prices directly and indirectly. The impact on non-energy industrial goods and services prices is 0.03% and 0.02% after 16 quarters, respectively. Taking together the HICP components, the aggregate effect on the HICP excluding unprocessed food and energy is about 0.03% after 16 quarters.

This larger impact of total commodity price changes compared with the impact of the energy commodity price changes only (as used by most other studies) suggests that one would miss significant variables in the determination of euro area producer and consumer prices when not taking them into account.

Chart 9 Impact multiplier of all commodity prices

(deviation from baseline following 1% increase in all commodity prices)



PPENE: PPI energy; PPINT: PPI intermediate goods; PPCONS: PPI consumer goods; CPFDPR: HICP processed food; CPNEIG: HICP non-energy industrial goods; CPSERV: HICP services, CPEX: HICP excluding unprocessed food and energy.

Again, we cross-check our results using input-output tables for the three PPI components and for total consumer prices. Table 6 shows the share of imported inputs of each of the commodities analysed above divided by the total output for each sector (first column), using the same source as in Table 5. The second column shows the impact of a 1% increase in the price of each of the commodities after 4 years, according to our estimation results.

Obviously, the share of imported energy commodities in total output of the energy sector is highest (26%), while it much smaller for the other sectors. Food commodities appear to be an important input only for the production of consumer goods. Finally, industrial raw materials are most important for the production of intermediate goods. It is striking how similar our estimations are to these shares, both in terms of relative impact and size, which indicates that our estimations seem to capture very well the pricing chain of the economy.

Table 6 Imported commodity input shares versus estimation results of 1% rise in commodity prices

Imported inputs / total output		Estimated impact after 4 years	
Energy commodities			
Production of:		Producer prices:	
Energy	0.26	Energy	0.26
Intermediate goods	0.01	Intermediate goods	0.04
Consumer goods	0.00	Consumer goods	0.02
Consumption	0.01	HICPX	0.01
Food commodities			
Production of:		Producer prices:	
Energy	0.00	Energy	-
Intermediate goods	0.00	Intermediate goods	-
Consumer goods	0.02	Consumer goods	0.02
Consumption	0.02	HICPX	0.02
Industrial raw material			
Production of:		Producer prices:	
Energy	0.00	Energy	-
Intermediate goods	0.12	Intermediate goods	0.11
Consumer goods	0.01	Consumer goods	0.02
Consumption	0.01	HICPX	0.01

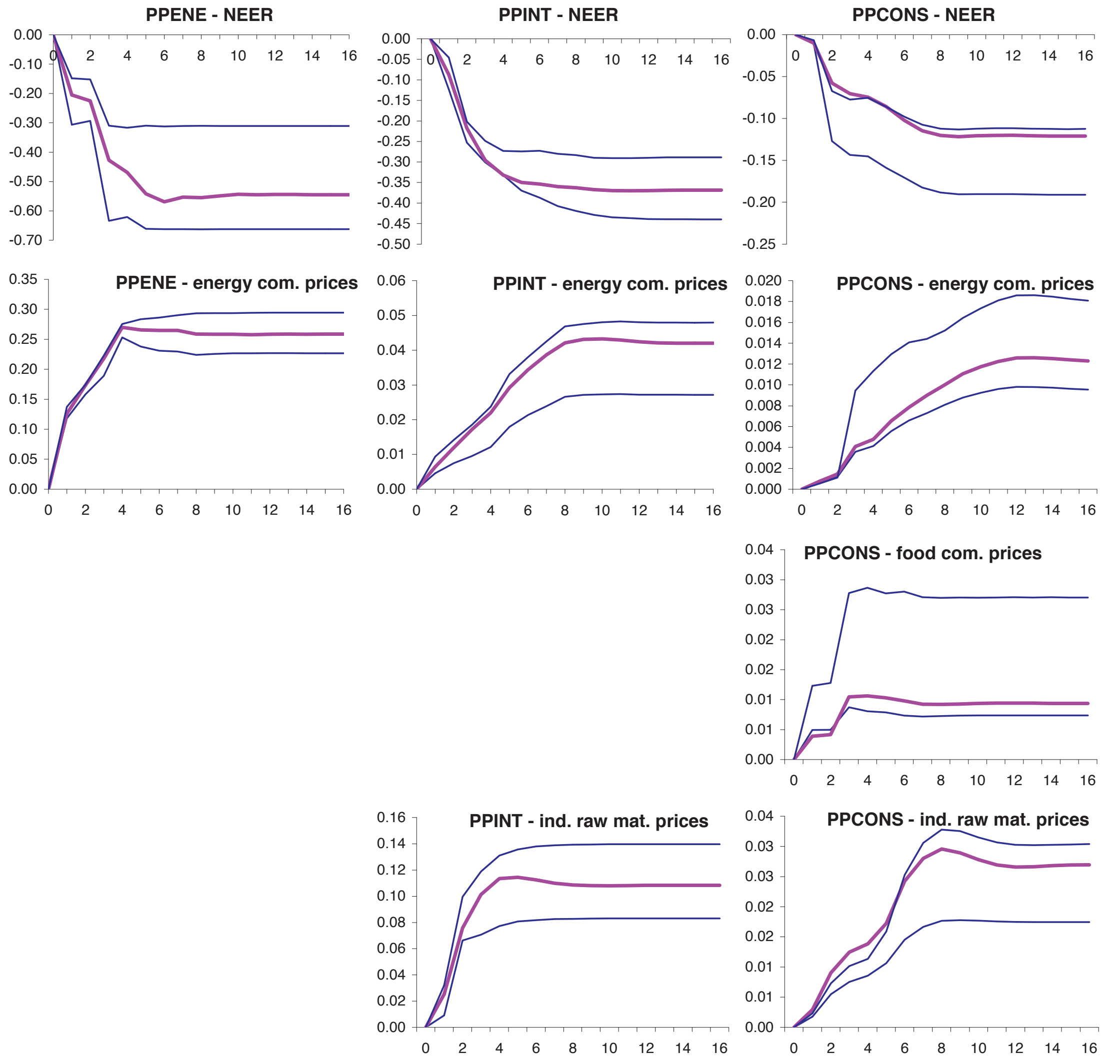
Source: Eurostat and own calculations.

As the standard errors of our regressions only show the uncertainty around our point estimates and not around the transmission through the pricing chain, we have also used bootstrapping in order to obtain confidence bands around our impact multipliers. These confidence bands are obtained in the following way: taking as an example the PPI consumer goods component, we first estimate the equations for PPI energy and intermediate goods, which are situated at earlier stages of the production chain, and compute their impact multipliers. Then, we estimate the equation for PPI consumer goods, store the residuals of this equation and compute the impact multiplier. We then re-order randomly the residuals of the PPI consumer goods equation for each country in the panel, apply them to the fitted values and re-estimate the equation with these bootstrapped data for PPI consumer goods in order to obtain a second version of an impact multiplier for this component. After 10,000 replications of this procedure, we take out the upper and lower 2.5% of the total of 10,000 impact multipliers for this component (sorted by the impact after 16 quarters) and thereby obtain a confidence band of 95%. The results for producer prices are shown in Chart 10, those for consumer prices in

Chart 11. Each row shows the impact of one shocked variable (NEER, energy commodity prices, food commodity prices and industrial raw material prices) on one component of either PPI or the HICP.

Chart 10 Confidence bands for producer prices

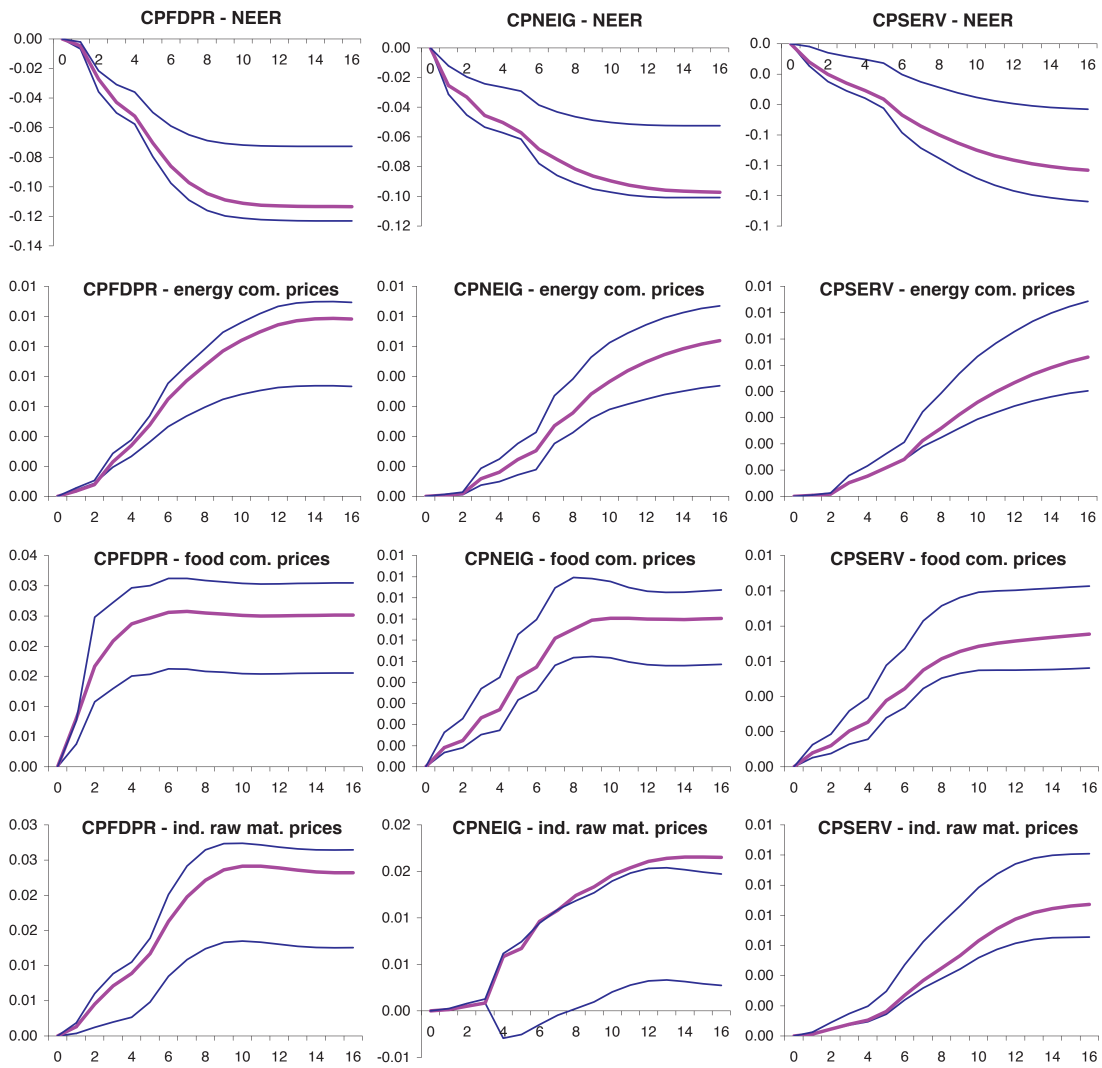
(deviation from baseline following 1% increase in effective exchange rate, energy price or non-energy commodity prices)



PPENE: PPI energy; PPINT: PPI intermediate goods; PPCONS: PPI consumer goods; NEER: nominal effective exchange rate of the euro.

Chart 11 Confidence bands for consumer prices

(deviation from baseline following 1% increase in effective exchange rate, energy price or non-energy commodity prices)



CPFDPR: HICP processed food; CPNEIG: HICP non-energy industrial goods; CPSERV: HICP services; NEER: nominal effective exchange rate of the euro.

There are several conclusions which can be drawn from the confidence intervals. First of all, the results show that the estimates of the impact multipliers are significantly different from zero at 5% in all cases except for the impact of industrial raw material prices on non-energy industrial goods consumer prices where the confidence bands include zero from 3 to 7 quarters. Second, due to the non-standard approach of estimating successively impact multipliers along the pricing chain, some of the simulations lay outside the confidence bands. This is the case for the impact of industrial raw material prices on the producer price of consumer goods (during the 1st year), and for the impact of industrial raw material prices on the HICP non-energy industrial goods, where the simulation is close to the upper band over the first 3 years and exceeds the band thereafter. Third, the impulse responses reported in

Charts 6-9, which are shown here in purple, are roughly in the middle of the confidence interval for most simulations, except for most simulations for consumer goods producer prices and the exchange rate and industrial raw material price impact on non-energy industrial goods prices.

4. Concluding remarks

The analysis of the pricing chain for producer and consumer prices reveals significant inter-linkages between the different price stages in the euro area, thereby demonstrating that external shocks, such as increases in commodity prices and exchange rate movements, are passed on sequentially to consumers. These links are generally not captured by macro-econometric models which might be the reason why our small and partial pricing model is still capable of reproducing relatively similar results. Second, the inclusion of non-energy commodity prices in the analysis reveals that these are rather important determinants of euro area prices but have so far been left mostly out of the analysis in the existing literature. Third, the distinction between goods and services prices gives a more refined view on the determinants of these prices, which may help to better understand their developments.

Our results suggest that a shock to the nominal effective exchange rate of the euro has a direct effect on most HICP components, but also indirect effects via the producer price components. In general, the size and timing of these effects is similar to what has been found in the literature at an aggregate level when taking into account that we have used the HICP excluding unprocessed food and energy in our estimations. Meanwhile, energy and food commodity and industrial raw material price shocks have a direct effect on producer prices and pass-through indirectly, via these components, to consumer prices, except for food commodity prices which also have a direct impact on processed food consumer prices. The estimation results are consistent with the shares of imports of each sector by its output as measured in input-output tables. An analysis of bootstrapped confidence intervals shows that for most simulations, the confidence bands are relatively narrow in most cases and suggest that the pricing chain is working in the expected way. It should be noted that this study does not take into account monetary policy responses to increases in inflation.

5. References

Álvarez Luis J., E. Dhyne, M.M. Hoeberichts, C. Kwapil, H. Le Bihan, P. Lünnemann, F. Martins, R. Sabbatini, H. Stahl, P. Vermeulen and J. Vilmunen (2006), Sticky Prices in the Euro Area: A Summary of New Micro Evidence, Journal of the European Economic Association, 4: 575-584.

Bailliu, J. and E. Fujii (2004), Exchange Rate Pass-Through and the Inflation Environment in Industrialised Countries: an Empirical Investigation, Bank of Canada Working Paper Series, 04-21.

Bussière, M., and T. Peltonen (2008), Exchange Rate Pass-Through – the Role of Emerging Market Economies, ECB Working Paper Series, 951.

Campa, J. M. and L. Goldberg (2006a), Distribution Margins, Imported Inputs, and the Sensitivity of the CPI to Exchange Rates, NBER Working Papers, 12121.

Campa, J. M. and L. Goldberg (2006b), Pass Through of Exchange Rates to Consumption Prices: What has Changed and Why?, NBER Working Papers, 12547.

Campa, J. M. and J. M. González Mínguez (2006), Differences in Exchange Rate Pass-Through in the Euro Area, European Economic Review, 50 (1): 121-45.

Choudhri, E. U., H. Faruqee and D. S. Hakura (2002), Explaining the Exchange Rate Pass-Through in Different Prices, IMF Working Papers, WP/02/224.

Choudhri, E. U. and D. S. Hakura (2002), Exchange Rate Pass-Through to Domestic Prices: Does the Inflationary Environment Matter?, IMF Working Paper WP/01/194.

European Central Bank (2004), Oil Prices and the Euro Area Economy, Monthly Bulletin, November, 51-64.

European Commission (2004), How Vulnerable is the Euro Area Economy to Higher Oil Prices?, Quarterly Report on the Euro Area, 3(2):15-20.

Faruqee, H. (2006), Exchange Rate Pass-Through in the Euro Area, IMF Staff Papers, 53(1): 63-88.

Gagnon, J. E. and J. Ihrig (2004), Monetary Policy and Exchange Rate Pass-Through, International Journal of Finance and Economics, 9 (4): 315-38.

Hahn, E. (2003), Pass-Through of External Shocks to Euro Area Inflation, ECB Working Paper Series, 243.

Hahn, E. (2007), The Impact of Exchange Rate Shocks on Sectoral Activity and Prices in the Euro Area, ECB Working Paper Series, 796.

Hüfner, F. P. and M. Schröder (2002), Exchange Rate Pass-Through to Consumer Prices: A European Perspective, ZEW Discussion Papers, 02-20.

Judson, R. and A.L. Owen (1999), Estimating Dynamic Panel Data Models: A Guide for Macroeconomists, Economics Letters, 65(1): 9-15.

McCarthy, J. (2000), Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies, Federal Reserve Bank of New York, Staff Report, 3.

Musso, A., L. Stracca and D. van Dijk (2009), Instability and Nonlinearity in the Euro Area Phillips Curve, International Journal of Central Banking, 5(2): 181-212.

Appendix I Data sources and availability

Variable	Description	Source
PPI	Producer price indices for energy, intermediate and consumer goods prices (index 2000=100)	Eurostat
HICP	Harmonised consumer price indices for processed food, non-energy industrial goods, services and overall prices excluding unprocessed food and energy (index 2005 = 100)	Eurostat
Exchange rate	Nominal effective exchange rate of the national currency/euro, narrow group of countries (index 2000=100)	BIS
Commodity prices	Commodity price indices for energy, food and tropical beverages, and industrial raw materials, in USD, weighted according euro area imports (index 2000=100)	HWWI
Output gap	Difference between real GPD and potential output (derived with an HP filter, smoothing parameter 1600)	Own calculation based on Eurostat data
Unit labour costs	Total unit labour costs, i.e. compensation per employee divided by value added per person employed (index 2000=100)	Eurostat
VAT	Standard value added tax rate applied in the Member States of the euro area	European Commission
Energy tax	Special excise duty on unleaded gasoline in national currency per litre, used as a proxy for total energy tax levy	International Energy Agency
Extra-openness	Extra-euro area trade openness, ratio between real extra imports of each country and real GDP	Own calculation based on Eurostat data

Start of sample period

		AT	BE	DE	ES	FR	GR	IT	LU	NL	PT
Endogenous	PPI_ENE	1996Q1	1980Q1	1980Q1	1980Q1	1995Q1	1995Q1	1985Q1	2000Q1	2000Q1	1990Q1
	PPI_INT	1996Q1	1980Q1	1990Q1	1980Q1	1980Q1	1995Q1	1991Q1	1980Q1	1985Q1	1995Q1
	PPI_CONS	1996Q1	1980Q1	1985Q1	1980Q1	1980Q1	1995Q1	1985Q1	1995Q1	1995Q1	1995Q1
	HICP_FDPR	1987Q1	1991Q1	1985Q1	1992Q1	1990Q1	1989Q1	1987Q1	1995Q1	1987Q4	1987Q1
	HICP_NEIG	1987Q1	1991Q1	1985Q1	1992Q1	1990Q1	1989Q1	1987Q1	1995Q1	1987Q4	1988Q1
	HICP_SERV	1987Q1	1991Q1	1985Q1	1992Q1	1990Q1	1989Q1	1987Q1	1995Q1	1987Q4	1987Q1
Exogenous	NEER	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1
	COMENE	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1
	COMFD	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1
	COMIRM	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1	1980Q1
	VAT	1980Q1	1980Q1	1980Q1	1986Q1	1980Q1	1987Q1	1980Q1	1980Q1	1980Q1	1986Q1
	ULC	1988Q1	1981Q1	1991Q1	1980Q1	1980Q1	1995Q1	1980Q1	1985Q1	1987Q1	1995Q1
	YGAP	1988Q1	1980Q1	1991Q1	1980Q1	1980Q1	1980Q1	1980Q1	1985Q1	1980Q1	1995Q1
	EXTRA_OPEN	1996Q1	1989Q1	1991Q1	1989Q1	1989Q1	1989Q1	1989Q1	1999Q1	1989Q1	1995Q!
	ENETAX	1985Q2	1990Q1	1986Q1	1990Q3	1985Q1	1992Q1	1985Q1	1988Q1	1989Q1	2004Q1

Note: All data end in 2005Q5. Data marked grey denotes the variable with the shortest sample.

Appendix II Estimation results

PPENE

Fixed-effects (within) regression — Number of obs = 401
Group variable: country_id — Number of groups = 10

R-sq: within = 0.5598 — Obs per group: min = 6
between = 0.8228 — avg = 40.1
overall = 0.5611 — max = 65

F(9,9) = 171.77
corr(u_i, Xb) = -0.0022 — Prob > F = 0.0000

(Std. Err. adjusted for 10 clusters in country_id)

dlppene	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dl1lppene	.0958436	.082228	1.17	0.274	-.0901691	.2818564
dl2lppene	.0053946	.0452801	0.12	0.908	-.0970361	.1078253
dl3lppene	.1065751	.0183847	5.80	0.000	.064986	.1481643
dl4lppene	-.1154779	.0357531	-3.23	0.010	-.1963571	-.0345987
dlneer	-.2052156	.0563793	-3.64	0.005	-.3327544	-.0776768
dl2lneer	-.1993337	.0377732	-5.28	0.001	-.2847826	-.1138848
dl4lneer	-.0902247	.0271856	-3.32	0.009	-.1517227	-.0287267
dlcomene_usd	.125906	.0141915	8.87	0.000	.0938025	.1580094
dl1lcomene~d	.0355156	.0197834	1.80	0.106	-.0092376	.0802689
dl2lcomene~d	.0392264	.0070173	5.59	0.000	.0233522	.0551006
dl3lcomene~d	.0340661	.0074328	4.58	0.001	.0172519	.0508803
dl2lulc	.1652284	.0583563	2.83	0.020	.0332173	.2972394
dl1lenetax	-.0542611	.0145314	-3.73	0.005	-.0871335	-.0213888
dl2extra_o~n	.3974291	.1820416	2.18	0.057	-.0143775	.8092357
_cons	.0017516	.0009855	1.78	0.109	-.0004777	.0039808
sigma_u	.00235128					
sigma_e	.01779186					
rho	.01716505	(fraction of variance due to u_i)				

PPINT

Fixed-effects (within) regression — Number of obs = 504
Group variable: country_id — Number of groups = 10

R-sq: within = 0.5022 — Obs per group: min = 19
between = 0.8515 — avg = 50.4
overall = 0.5147 — max = 99

F(9,9) = 447.35
corr(u_i, Xb) = 0.1363 — Prob > F = 0.0000

(Std. Err. adjusted for 10 clusters in country_id)

dlppint	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dl1lppint	.4786593	.0997018	4.80	0.001	.2531182	.7042003
dl2lppint	.0574931	.0174489	3.29	0.009	.0180211	.0969652
dl3lppint	-.1237905	.0530452	-2.33	0.044	-.2437871	-.003794
dlppene	.0512379	.0152577	3.36	0.008	.0167225	.0857533
dl4lppene	.0443517	.0168835	2.63	0.027	.0061584	.0825449
dlneer	-.076546	.0210156	-3.64	0.005	-.1240866	-.0290053
dl1lneer	-.0878317	.0198313	-4.43	0.002	-.1326931	-.0429702
dlcomirm_usd	.025124	.00621	4.05	0.003	.0110759	.0391721
dl1lcomirm~d	.0385389	.018898	2.04	0.072	-.0042113	.0812891
dygap	.0008126	.0003716	2.19	0.057	-.0000281	.0016533
_cons	.001733	.0007214	2.40	0.040	.000101	.0033649
sigma_u	.00184886					
sigma_e	.00850972					
rho	.04507585	(fraction of variance due to u_i)				

PPCONS

```
Fixed-effects (within) regression               Number of obs      =       474
Group variable: country_id                      Number of groups   =        10

R-sq:  within  = 0.2943                         Obs per group: min =        23
       between = 0.8924                                        avg =      47.4
       overall = 0.3547                                        max =        63

                                                F(9,9)             =    306.88
corr(u_i, Xb)  = 0.2786                         Prob > F           =    0.0000

                            (Std. Err. adjusted for 10 clusters in country_id)
------------------------------------------------------------------------------
             |               Robust
    dlppcons |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  dl1lppcons |   .3062732   .0274635    11.15   0.000     .2441464       .3684
  dl2lppcons |   .0325866   .0410125     0.79   0.447     -.06019     .1253633
  dl3lppcons |  -.0212221   .0636199    -0.33   0.746    -.1651402    .1226961
  dl4lppcons |  -.1666132   .0871878    -1.91   0.088    -.3638458    .0306194
     dlppint |    .067452   .0333476     2.02   0.074    -.0079855    .1428894
   dl4lppint |   .1192051   .0228623     5.21   0.001     .0674869    .1709233
    dl1lneer |  -.0625331   .0156578    -3.99   0.003    -.0979534   -.0271128
dl2lcomene~d |   .0048596   .0018817     2.58   0.030      .000603    .0091163
 dlcomfd_usd |   .0102573    .003183     3.22   0.010     .0030568    .0174579
dl2lcomfd_~d |   .0066864   .0019484     3.43   0.007     .0022788     .011094
     dl4ygap |   .0006276   .0001386     4.53   0.001      .000314    .0009411
dl4extra_o~n |  -.2485053   .0710945    -3.50   0.007    -.4093322   -.0876783
       _cons |   .0028931   .0003904     7.41   0.000       .00201    .0037763
-------------+----------------------------------------------------------------
     sigma_u |  .00217538
     sigma_e |  .00453178
         rho |  .18727353   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

CPFDPR

```
Fixed-effects (within) regression               Number of obs      =       464
Group variable: country_id                      Number of groups   =        10

R-sq:  within  = 0.3386                         Obs per group: min =        25
       between = 0.9386                                        avg =      46.4
       overall = 0.4188                                        max =        62

                                                F(9,9)             =    951.56
corr(u_i, Xb)  = 0.1702                         Prob > F           =    0.0000

                            (Std. Err. adjusted for 10 clusters in country_id)
------------------------------------------------------------------------------
             |               Robust
    dlcpfdpr |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  dl1lcpfdpr |   .2833939   .0560866     5.05   0.001     .1565173    .4102706
     dlppint |   .0385946   .0169206     2.28   0.048     .0003176    .0768717
   dl4lppint |   .0427676   .0124113     3.45   0.007     .0146912    .0708441
    dlppcons |   .2224857   .0680644     3.27   0.010     .0685132    .3764581
  dl3lppcons |   .1090497   .0492784     2.21   0.054    -.0024259    .2205252
 dlcomfd_usd |   .0057225   .0030047     1.90   0.089    -.0010747    .0125196
dl1lcomfd_~d |     .00566    .001888     3.00   0.015      .001389     .009931
       dlulc |   .0449365   .0245122     1.83   0.100    -.0105139    .1003868
       dlvat |   .0665186   .0123724     5.38   0.000     .0385304    .0945069
 dextra_open |  -.3755812   .0611567    -6.14   0.000    -.5139273   -.2372351
dl1extra_o~n |  -.2544587   .0354874    -7.17   0.000    -.3347367   -.1741807
dl2extra_o~n |   .1323513   .0757606     1.75   0.115    -.0390312    .3037338
       _cons |   .0027263   .0004964     5.49   0.000     .0016033    .0038494
-------------+----------------------------------------------------------------
     sigma_u |  .00063073
     sigma_e |  .00440007
         rho |   .0201343   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

CPNEIG

Fixed-effects (within) regression		Number of obs =	490
Group variable: country_id		Number of groups =	10
R-sq: within = 0.3811		Obs per group: min =	35
between = 0.9452		avg =	49.0
overall = 0.5265		max =	73
		F(9,9) =	708.74
corr(u_i, Xb) = 0.3986		Prob > F =	0.0000

(Std. Err. adjusted for 10 clusters in country_id)

dlcpneig	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dl1lcpneig	.0501821	.0646243	0.78	0.457	-.0960082	.1963724
dl2lcpneig	.373533	.037572	9.94	0.000	.2885392	.4585268
dlppcons	.0893961	.0315061	2.84	0.019	.0181243	.1606678
dl4lppcons	.1143864	.0513311	2.23	0.053	-.0017325	.2305054
dl3lcomirm~d	.0046689	.0020943	2.23	0.053	-.0000688	.0094065
dlneer	-.0248823	.0125983	-1.98	0.080	-.0533816	.0036169
dlulc	.0595285	.0192207	3.10	0.013	.0160483	.1030088
dl4lulc	.0343244	.0144247	2.38	0.041	.0016934	.0669553
dygap	.0006376	.0003476	1.83	0.100	-.0001488	.0014239
dlvat	.0587554	.0150832	3.90	0.004	.0246348	.0928761
dl1lvat	.0427205	.0111951	3.82	0.004	.0173953	.0680457
_cons	.0003835	.0003563	1.08	0.310	-.0004226	.0011895
sigma_u	.00065078					
sigma_e	.0030686					
rho	.04304129	(fraction of variance due to u_i)				

CPSERV

Fixed-effects (within) regression		Number of obs =	464
Group variable: country_id		Number of groups =	10
R-sq: within = 0.5350		Obs per group: min =	26
between = 0.9461		avg =	46.4
overall = 0.6475		max =	66
		F(9,9) =	82.71
corr(u_i, Xb) = 0.1041		Prob > F =	0.0000

(Std. Err. adjusted for 10 clusters in country_id)

dlcpserv	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
dl1lcpserv	.1971393	.0689225	2.86	0.019	.0412258	.3530527
dl2lcpserv	.1652625	.0554974	2.98	0.016	.0397187	.2908064
dl3lcpserv	.1157118	.0446581	2.59	0.029	.0146881	.2167356
dl4lcpserv	.0892001	.0427406	2.09	0.067	-.0074858	.185886
dlppcons	.0779006	.0275272	2.83	0.020	.0156298	.1401714
dl4lppcons	.0907917	.0350953	2.59	0.029	.0114006	.1701828
dlneer	-.0116737	.0063548	-1.84	0.099	-.0260493	.0027018
dlulc	.0475384	.0188764	2.52	0.033	.0048369	.0902398
dl4lulc	.0508087	.0142826	3.56	0.006	.0184992	.0831183
dlvat	.0458296	.0072121	6.35	0.000	.0295147	.0621444
dextra_open	-.1544247	.0374258	-4.13	0.003	-.2390878	-.0697616
dl1extra_o~n	-.1625198	.0539966	-3.01	0.015	-.2846686	-.0403709
_cons	.0019854	.0004333	4.58	0.001	.0010051	.0029657
sigma_u	.00052359					
sigma_e	.00248292					
rho	.04257555	(fraction of variance due to u_i)				

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