Appendix: Model Mathematical Specification for the paper titled:
"Estimating the U.S. Dollar depreciation effect on oil prices"

$$\pi_{OPEC} = \sum_s \sum_c QS_{cs} * (PS_{cs} - E * MC_{cs}) \qquad\qquad \forall\, s \in \text{OPEC} \qquad (1)$$

$$E * \frac{A * QS_{cs}^{\psi_{cs}}}{(\overline{QS}_{cs} - QS_{cs})} - PS_{cs} = 0 \qquad\qquad \forall\, s \qquad (2)$$

$$QS_{cs} - \sum_r \left(M_{cr} * \left[\frac{\theta_{csr} * \left(\left[\sum_s \theta_{csr}^{\sigma_{cr}} \ (PS_{cs} + \rho_{csr})^{1-\sigma_{cr}} \right]^{1/1-\sigma_{cr}} \right)^{\sigma_{cr}}}{PS_{cs} + \rho_{csr}} \right] \right) = 0 \qquad \forall\, s \qquad (3)$$

$$\left(M_{cr} * \left[\left[\sum_s \theta_{csr}^{\sigma_{cr}} \ (PS_{cs} + \rho_{csr})^{1-\sigma_{cr}} \right]^{1/1-\sigma_{cr}} \right] \right) + \left(M_{cr} * \upsilon_{cr} * PI_{cr} \right) - \left(\sum_p \left((M_{cr} * \eta_{rcp}) * \right. \right.$$

$$\left. \left. PS_{pr} \right) \right) = 0 \qquad \forall\, s \qquad (4)$$

$$\sum_c (A_{cs} * \eta_{rcp}) - \sum_d \left[M_{pd} * \left[\frac{\theta_{prd} * \left[\sum_r \theta_{prd}^{\sigma_{pd}} \ (PS_{pr} + \rho_{prd})^{1-\sigma_{pd}} \right]^{1/1-\sigma_{pd}}}{PS_{pr} + \rho_{prd}} \right]^{\sigma_{pd}} \right] \qquad \forall\, s \qquad (5)$$

$$\left[\sum_r \theta_{prd}^{\sigma_{pd}} \ (PS_{pr} + \rho_{prd})^{1-\sigma_{pd}} \right]^{1/1-\sigma_{pd}} - E * QD_{pd}^{-\beta_{pd}} = 0 \qquad\qquad \forall\, s \qquad (6)$$

where,

Sets include:

s	Set of crude producers
r	Set of crude refiners
d	Set of product consumers
c	Set of crude types
p	Set of refined product types

Parameters (exogenous) include:

E	Chnages in exchange rate (%)
$\overline{QS}_{cs}$	Production capacity of crude (c) at producing region (s) in 10^6Bbl/D
ρ_{csr}	Crude (c) transport cost from producer (s) to refiner (r) in \$/Bbl
ρ_{prd}	Product (p) transport cost from refiner (r) to consumer (d) in \$/Bbl
η_{rcp}	Refining yields at refiner (r), for refined product (p) from crude (c) in %
γ_{cs}	Inverse of the price elasticity of supply of crude (c) for producer (s)
v_{cr}	Initial value added for inputs at refiner (s) for crude (c) in \$
β_{pd}	Inverse of the price elasticity of demand of product (p) for consumer (d)
θ_{csr}	Share of crude (c) imported from producer (s) to refiner (r) in % (Calculated)
θ_{prd}	Share of product (p) imported from refiner (r) to consumer (d) in % (Calculated)
σ_{cr}	Armington elasticity of substitution between imported and domestic crude (c) at refining region (r)
σ_{pd}	Armington elasticity of substitution between imported and domestic product (p) at consumer (d)

Variables (benchmark) include:

$QS0_{cs}$	Initial crude (c) supply from producer (s) in 10^6Bbl/D
$PS0_{cs}$	Initial crude (c) Free On Board (FOB) price at producer (s) gate in \$/Bbl
$PD0_{cr}$	Initial crude (c) Cargo, Insurance and Fright (CIF) price at refiner (r) gate in \$/Bbl
$QS0_{prd}$	Initial product (p) supply/exports from refiner (r) to consumer (d) in 10^6Bbl/D
$PS0_{pr}$	Initial product (p) Free On Board (FOB) price at refiner (r) gate in \$/Bbl
$PD0_{pd}$	Initial product (p) Cargo, Insurance and Fright (CIF) price at consumer (d) gate in \$/Bbl
τ_{cs}	Initial markup in % (Calculated)
$M0_{cr}$	Initial Composite of imports of crude (c) at refiner (r) in10^6Bbl/D

Variables (endogenous) include:

π_s	Profits from crude production operations for any crude producer (s) in \$$10^6$
QS_{csr}	Crude (c) supply/exports from producer (s) to refiner (r) in 10^6Bbl/D
QS_{cs}	Crude (c) supply/exports from producer (s) in 10^6Bbl/D
MC_{cs}	Marginal cost of crude (c) at producing region (s) in \$/Bbl
QD_{csr}	Crude (c) imports/demand from producer (s) to refiner (r) in 10^6Bbl/D
PS_{cs}	Crude (c) Free On Board (FOB) price at producer (s) gate in \$/Bbl
PD_{cr}	Crude (c) Cargo, Insurance and Fright (CIF) price at refiner (r) gate in \$/Bbl
C_{cr}	Unit cost function for crude (c) at refiner (r)
RL_{cr}	Refining level of crude type (c) at refiner (r) in%
M_{cr}	Composite of imports of crude (c) at refiner (r) in10^6Bbl/D
PI_{cr}	Price index on value added inputs of crude (c) at refiner (r) = $(M_{cr}/M0_{cr})^{1.1}$
QS_{pr}	Product (p) exports/supply by refiner (r) in 10^6Bbl/D
QD_{prd}	Product (p) demand by consumer (d) from refiner (r) in 10^6Bbl/D
QD_{pd}	Product (p) demand by consumer (d) in 10^6Bbl/D
PS_{pr}	Product (p) Free On Board (FOB) price at refiner (r) gate in \$/Bbl
PD_{pd}	Product (p) Cargo, Insurance and Fright (CIF) price at consumer (d) gate in \$/Bbl
C_{pd}	Unit cost function for product (p) at consumer (d)
ψ_{cs}	Function of the inverse of the price elasticity of supply of crude (c) for producer (s)