Monetary Rules for Commodity Traders

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I. Motivation

Large swings in global commodity prices have posed challenges to headline CPI inflation targeting (IT).

In particular, commodity price boom and busts have been associated with large deviations from IT central targets in many countries.

More so in small open economies (SOEs) that export/import commodities and where commodities weigh heavily in CPI baskets.

Potential over- and under-tightening led some argue for alternatives to a headline CPI Taylor rule (e.g. Frankel, 2010, 2011; IMF, 2011).

Moreover, the theoretical literature never bought headline CPI targeting -- even for advanced countries -- recommending instead PPI IT.

II. What this paper does

Time seems ripe for a welfare –based re-appraisal.

We do that for a SOE facing fluctuating X and M prices of magnitudes commensurate with actual commodity price volatility *and* persistence.

- First novelty: Extends Catão-Chang (2010) to allow for a commodity export sector, imported inputs to production, and distinct international risk sharing scenarios.

- Second novelty: Provides clear, analytically derived benchmarks for the evaluation of distinct policy rules.

How?

We compute utility and key observables under Ramsey and Competitive flex-price allocations

The compare them with under distinct rules to find out where the welfare differences come from.

- Third novelty: we undertake extensive calibration and sensitivity analysis, including for new rules not previously examined using such welfare-based metrics.

- These calibrations allow identifying the crucial role of elasticities, production structure, and capital mobility.

III. Main Results

- The relative desirability of the different rules depends critically on the elasticities of substitution in demand and on the degree of international risk sharing.

- If international risk sharing is perfect and substitution elasticities around one: PPI is welfare superior, as emphasized in the literature.

- If, however, export price elasticities >>1, then expected CPI or Export price targeting win.

- If capital account is closed (portfolio autarky): PPI wins regardless of elasticities if commodity shocks are non-trivial.

IV. Model

Utility

$$E\sum_{t=0}^{\infty}\beta^{t}[u(C_t)-v(N_t)]$$

Home Consumption

$$C_t=\left[(1-\alpha)^{1/\eta}C_{ht}^{(\eta-1)/\eta}+\alpha^{1/\eta}C_{mt}^{(\eta-1)/\eta}\right]^{\eta/(\eta-1)}$$

CPI Basket

$$P_t=\left[(1-\alpha)P_{ht}^{1-\eta}+\alpha P_{mt}^{1-\eta}\right]^{1/(1-\eta)}$$

Home good Calvo Pricing

$$P_{ht}=\left[(1-\theta)\bar{P}_t^{1-\varepsilon}+\theta P_{h,t-1}^{1-\varepsilon}\right]^{1/(1-\varepsilon)}$$

FOC:

$$\frac{v'(N_t)}{u'(C_t)} = \varsigma C_t^{\sigma} N_t^{\varphi} = \frac{W_t}{P_t}$$

$$C_{ht} = (1-\alpha)\left(\frac{P_{ht}}{P_t}\right)^{-\eta} C_t$$

$$\frac{1}{1+i_t} = \beta E_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma} \frac{P_t}{P_{t+1}}\right]$$

International relative prices

$$P_{mt} = S_t P^*_{mt}$$ *LOP on importables*

$$Z^*_t = P^*_{mt}/P^*_t$$ *world relative price*

$$Q_t = \frac{P_{mt}}{P_{ht}} = \frac{S_t P^*_{mt}}{P_{ht}}$$ *Terms of Trade*

$$X_t = S_t P^*_t / P_t$$ *Real exchange rate*

$$x_t = (1-\alpha) q_t - z^*_t$$ ***Log-linearized RER***

→ RER and TOT can move in opposite directions when z* is non-trivial!

Thus distinct from the canonical SOE model where cov(x,q)>0 $\forall$ t.

Domestic Production

$$Y_t(j) = \iota A_t L_t(j)^{1-\varkappa} M_t(j)^{\varkappa}$$

With FOCs delivering the following ratio of inputs to labor:

$$\frac{M_t(j)}{L_t(j)} = \frac{M_t}{L_t} = \frac{\varkappa}{1-\varkappa} \frac{W_t(1-\upsilon)}{P_{mt}}$$

Competitive Export Sector

$$Y_{xt} = A_{xt} L_{xt}^{\varrho}$$

With FOCs delivering:

$$\varrho A_{xt} L_{xt}^{\varrho-1} = \frac{W_t}{S_t P_{xt}^*} = \frac{W_t}{X_t P_t} \frac{1}{Z_{xt}^*}$$

Export price relative to world P*. With ϱ<1 implies that a rise in Zx* increases employment.

Market Clearing

Home good: $$Y_{ht} = (1-\alpha)\left(\frac{P_{ht}}{P_t}\right)^{-\eta} C_t + \phi\left(\frac{P_{ht}}{S_t P_t^*}\right)^{-\gamma} C_t^*$$

Imperfect International competition for home good:
finite price elasticity of foreign demand + stickiness of Ph
= monetary policy can affect TOT ("tot externality")

Labor market: $$N_t = L_t + L_{xt}$$

Value added Identity

$$V_t = P_{ht}Y_{ht} + S_t P_{xt}^* Y_{xt} - P_{mt}M_t = P_{ht}Y_{ht} + Z_{xt}^* X_t P_t A_{xt} L_{xt}^{\varrho} - Z_t^* X_t P_t M_t$$

The model then closes with an expression for international risk sharing and the chosen monetary policy rule:

International Risk Sharing

$$C_t = \left[\kappa X_t^{1/\sigma} C_t^* \right]^{\psi} \left[V_t / P_t \right]^{1-\psi}$$

We consider two polar cases:

$\psi = 1$ Perfect Risk Sharing

$\psi = 0$ Balanced Trade/Financial Autarky

Monetary Policy Rules

PPI IT: $$\log(1+i_t) = -\log\beta + \phi_\pi \pi_{ht} + \phi_y(\log Y_{ht} - \log Y_{ht}^n) + v_t$$

Headline CPI IT: $$\log(1+i_t) = -\log\beta + \phi_\pi \pi_t + \phi_y(\log Y_{ht} - \log Y_{ht}^n) + v_t$$

Expected CPI IT: $$\log(1+i_t) = -\log\beta + \phi_\pi E_t\pi_{t+1} + \phi_y E_t(\log Y_{ht+1} - \log Y_{ht+1}^n) + v_t$$

Export Price IT: $$\frac{S_t}{S_{t-1}}\frac{P_t^*}{P_{t-1}^*} = \frac{Z_{xt-1}^*}{Z_{xt}^*}$$

V. Dynamics

- The paper discusses IRs for both the import and the export price shock, focusing on key observables such as C, X, and N.
- Different rules will display a different IRs.
- Here we focus on the PPI rule*, distinguishing between full risk sharing and autarky.*
- Importantly, we also numerically calibrate Ramsey and competitive benchmark allocations, comparing to alternative rules. [see paper for derivation details]
- Emphasis on realistic calibration, particularly of commodity shocks.

Table 1: Model Calibration

Discount Factor	β	0.99
Coefficient of risk aversion	σ	[2,6]
Inverse of elasticity of labor supply	φ	1
Degree of Openness	α	0.25
Average period between price adjustments	θ	0.66
Coefficient on domestic inflation in Taylor Rule	ϕ_π	[1.5,5.0]
Coefficient on output gap in Taylor Rule	ϕ_y	[0,0.5]
Parameter of persistence associated with persistent monetary policy shock	ρ_v	0.6
Parameter of persistence associated with persistentce of export and import price shocks	ρ_z	[0.5,0.85]
Elasticity of substitution between varieties produced within any given country	ϵ	6
Elasticity of substitution between domestic and foreign goods	η	[0.5,5]
Ratio of initial home to foreign consumption	κ	1
Weight of labor in utility	ς	1
Share of imported inputs in production	$\varkappa$	[0,0.1]
Share of Labor in Export Sector	ρ_x	0.1
Relative Size (TFP) coefficient on Export Sector	ω_x	0.15
Price Elasticity of Foreign Demand for the home goods	γ	[0.5,5]
Standard Deviation associated with monetary policy shock	σ_v	0.006
Standard Deviation associated with relative import price shock	σ_z	[0,0.05]
Standard Deviation associated with relative export price shock	σ_x	0.07
Standard Deviation associated with productivity shock	σ_a	0.012

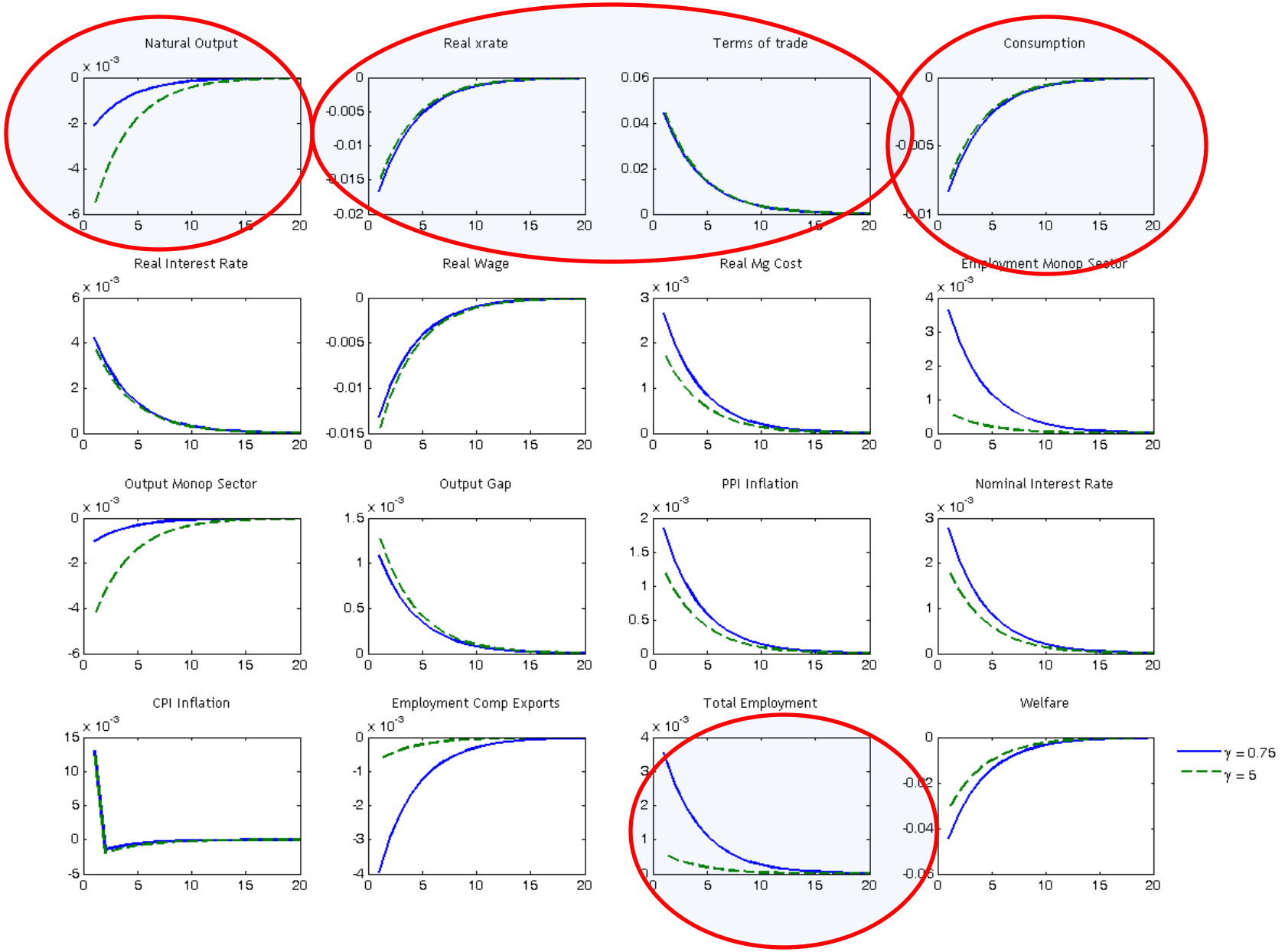

Figure 1: Responses to **Imports Price Shock, Perfect Risk Sharing**

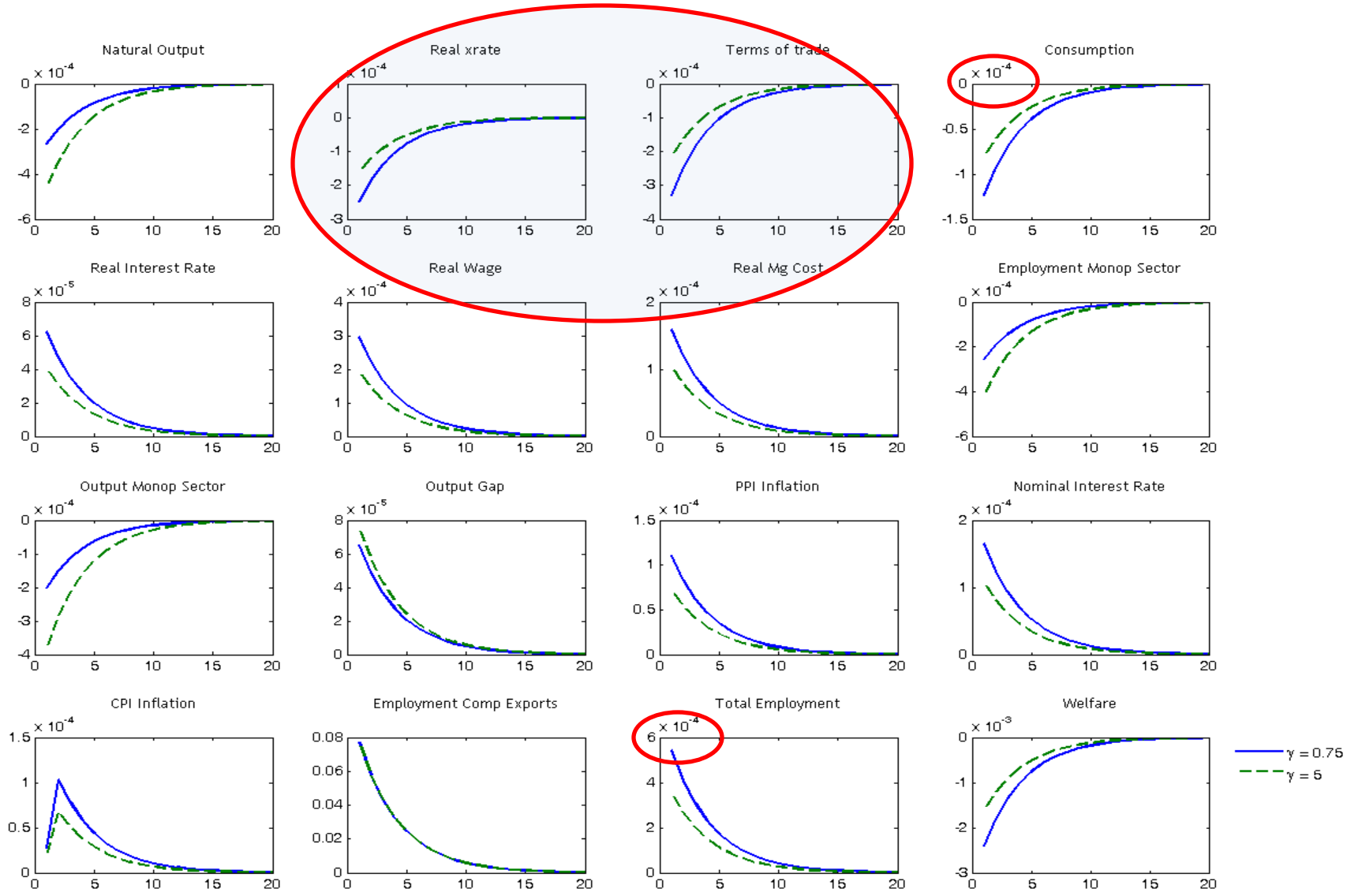

Figure 2: Responses to **Exports Price Shock, Perfect Risk Sharing**

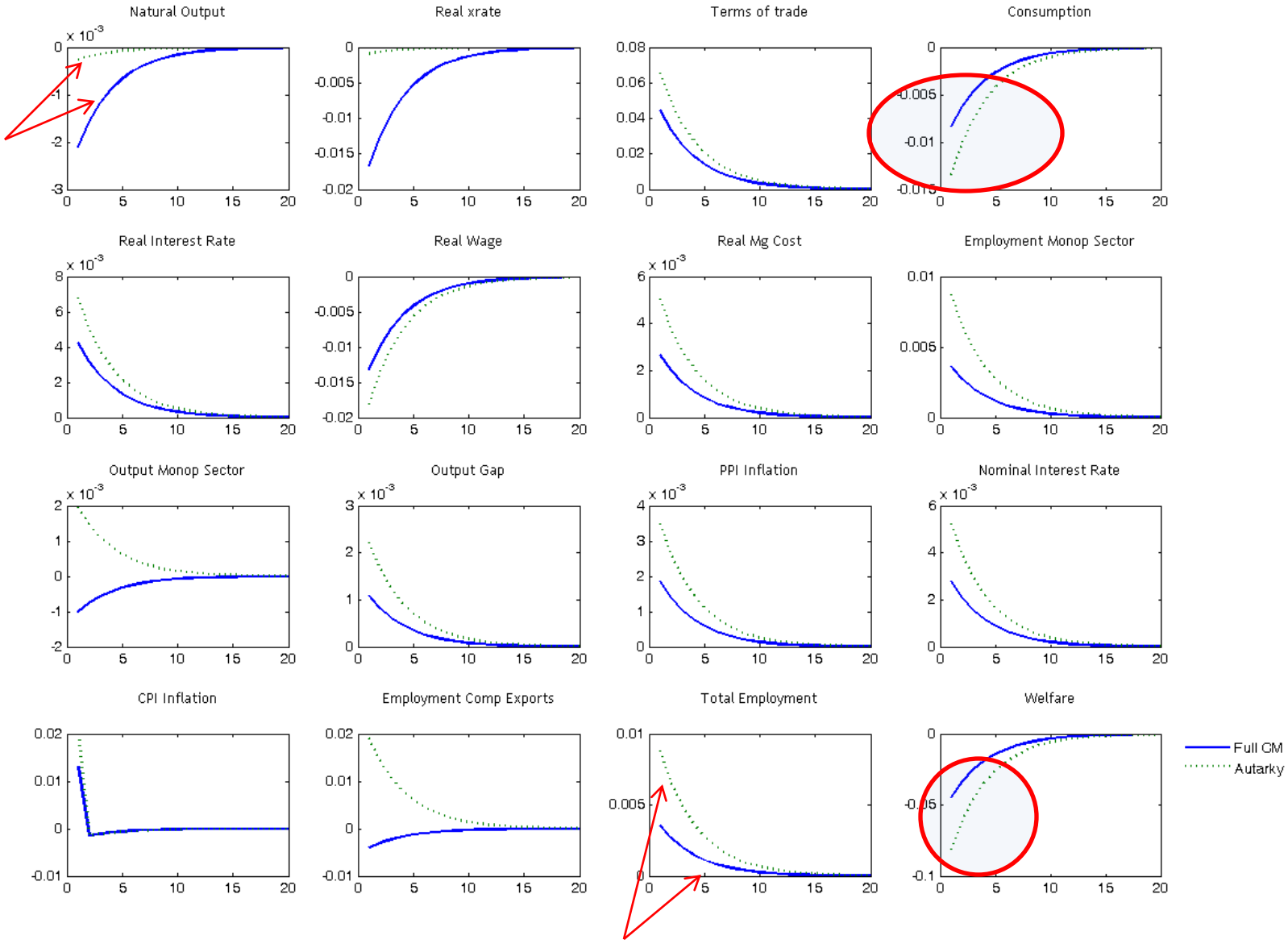

Figure 3: Responses **to Imports Price Shock, Full Capital Mobility vs Financial Autarky**

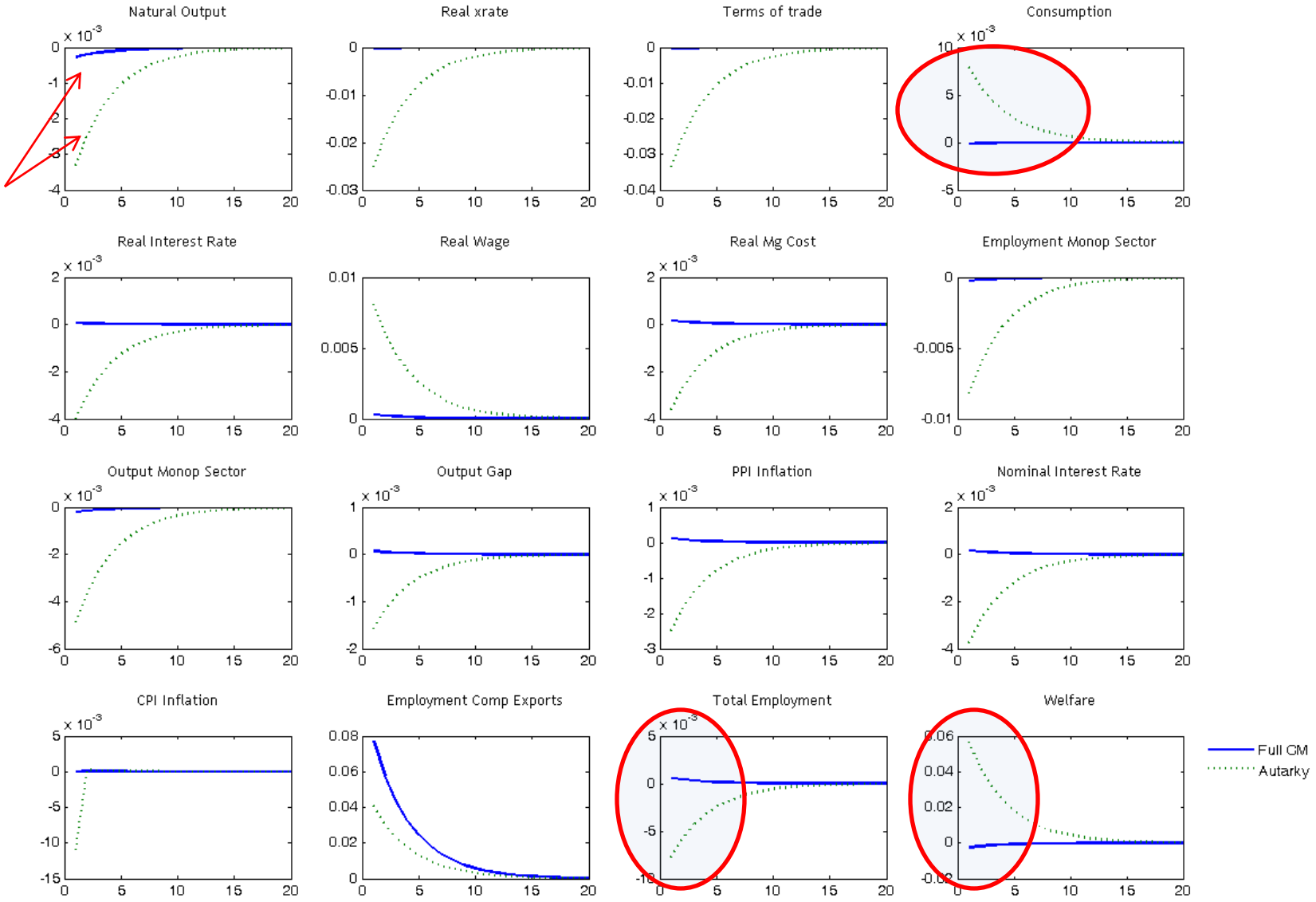

Figure 4: Responses to **Exports Price Shock, Full Capital Mobility vs Financial Autarky**

VI. Welfare Comparisons

- As discussed, the main aim of the paper is to revisit rankings across rules based on welfare-based criteria.

- As standard, we use second order approximation to welfare using the Schmitt-Grohe-Uribe algorithm but conditional on all rules starting from the same SS point.

- Unlike most previous work (except Kolmann, 2001), Taylor rules are optimized [see paper for specifics].

- We start from the same starting point as previous work (no shock to the SOE-specific commodity composite) and then build on.

Intuition behind welfare trade-offs between rules

As discussed, we rationalize these rankings as per what each rule delivers viz the Ramsey and competitive benchmarks

We focus here on complete markets [see paper for autarky case]

The social planner trade-off

FOC: $$\underbrace{u'(C_t)\frac{1}{\sigma}X_t^{1/\sigma-1}}_{\text{mrg. benefit of depreciation on consumption}} = \underbrace{\frac{v'(N_t)}{A_t}\Theta_1(X_t,Z_t)}_{\text{mrg. cost of depreciation on labor effort}}$$

where $\Theta(X,Z) = (1-\alpha)g(XZ)^{\eta}X^{1/\sigma} + \phi X^{\gamma}g(XZ)^{\gamma}$

Re-writing:

$$MRS_{planner} = \frac{v'(N_t)}{u'(C_t)} = \frac{A_t \frac{1}{\sigma} X_t^{1/\sigma - 1}}{\Theta_1(X_t, Z_t)} \qquad (1)$$

So, it is time varying when stochastic Z shocks are non-trivial

Competitive Market allocation

$$MRS_{market} = \frac{v'(N_t)}{u'(C_t)} = \frac{A_t}{\mu(1-v)g(X_t Z_t)} \qquad (2)$$

Insofar PPI IT tracks the latter and (1) and (2) are not in general the same, ***it follows that PPI is not always optimal***.!

With $\mu(1-v)=1$, the MRS gap is:

$$MRSgap = \frac{MRS^{planner}}{MRS^{market}} - 1 = \frac{1}{\sigma}\frac{X_t^{1/\sigma-1}g(X_tZ_t)}{\Theta_1(X_t,Z_t)} - 1$$

So, does not depend on productivity shocks but does depend crucially on the cov(X,Z) and the demand elasticities!

$$\eta = \gamma = 1/\sigma$$

In fact, this gap is only zero if, and only if, and $\mu(1-v) = \kappa + \frac{\phi}{(1-\alpha)}$. This the Gali-Monacelli et world.

As well as that of other previous studies that content that PPI dominates, given a suitable (fiscal) subsidy to production.

But it is possible to get some further intuition for the less restrictive case of $\eta = 1/\sigma$:

$$MRSgap^{\eta=1/\sigma} = \frac{1}{1+\frac{\gamma\phi}{\eta(1-\alpha)}X_t g(X_t,Z_t)^{\gamma-\eta}} - 1$$

If you take PPI as the rule that mimics the decentralized flex price equilibrium, its distance from the social planner allocation will increase on the REER appreciation and the cov(X,Z)!

So, a rule that appreciates RER on average and reduces that co-variance can potentially do better.

Back to what previous literature says

Closed economy models

- Goodfriend and King (1997) Aoki (2001) and others: PPI or "core" CPI IT should be preferred since mitigates the sticky price distortion and mimics the flexible price equilibrium.

- PPI also preferred if the "divine coincidence" coincidence does not hold, e.g., due to supply-shocks and wage rigidities (Blanchard and Gali, 2005, 2009).

- Then, still PPI but with a suitable weight on the output gap.

Previous open economy models

- Now ***extra friction*** from imperfect international competition .

- Allows national planner to use monetary policy to manipulate the country's TOT (so-called TOT externality).

  [Corsetti and Pesenti (2001), Benigno and Benigno (2003), Gali and Monacelli (2005), Faia and Monacelli (2007)]

- Yet, previous work finds that PPI IT still wins out CPI and PEG rules for the most part.

  [*Kollmann, 2001; Gali and Monacelli (2005); de Paoli, 2009]*

Yet, we just showed above that this is a particular rather than general result!

In what follows, we explore numerically how particular this result actually is. And unlike previous work, we do this by:

- Adding two new rules to the set: Exp. CPI & Exp. Price targeting
- Consider both full international risk sharing and portfolio autarky scenarios
- And when commodity prices are non-trivial, as in the real world.

Table 2. Welfare Gaps: Complete Markets with no Commodity Shocks
in % of Steady State Consumption

PPI-CPI

sigma/eta	**0.75**	**1**	**2**	**5**
2	0.0205	0.0167	0.0076	-0.0041
4	0.0182	0.0144	0.005	-0.006
6	0.0173	0.0137	0.0041	-0.0067

CPI-Expected CPI

sigma/eta	**0.75**	**1**	**2**	**5**
2	-0.0181	-0.0152	-0.0076	0.0049
4	-0.0167	-0.0133	-0.0051	0.0073
6	-0.0162	-0.0127	-0.0042	0.0081

CPI-EPT

sigma/eta	**0.75**	**1**	**2**	**5**
2	0.0219	0.0188	0.0093	-0.0066
4	0.0192	0.0158	0.0063	-0.0093
6	0.0181	0.0145	0.0051	-0.0103

PPI-EPT

sigma/eta	**0.75**	**1**	**2**	**5**
2	0.0024	0.0016	0	0.0008
4	0.0011	0.0011	-0.0001	0.0013
6	0.0005	0.0009	-0.0001	0.0014

PPI-Expected CPI

sigma/eta	**0.75**	**1**	**2**	**5**
2	0.0424	0.0355	0.0169	-0.0107
4	0.0373	0.0302	0.0113	-0.0153
6	0.0354	0.0282	0.0092	-0.0169

PEG-Expected CPI

sigma/eta	**0.75**	**1**	**2**	**5**
2	0.04	0.034	0.0168	-0.0115
4	0.0359	0.0291	0.0114	-0.0165
6	0.0343	0.0273	0.0093	-0.0183

Ranking matrix

sigma/eta	**0.75**	**1**	**2**	**5**
2	PPI	PPI	PPI	EXP(CPI)
4	PPI	PPI	EPT	EXP(CPI)
6	PPI	PPI	EPT	EXP(CPI)

Table 4a. Welfare Gaps: Complete Markets with All Shocks and Fixed Export Price Elasticity = 5

PPI-CPI

sigma/eta	**0.75**	**1**	**2**	**5**
2	0.0112	0.0104	0.0073	-0.0016
4	0.001	0	-0.0037	-0.0143
6	-0.0029	-0.0039	-0.0077	-0.019

CPI-EPT

sigma/eta	**0.75**	**1**	**2**	**5**
2	0.2809	0.2392	0.0751	-0.4659
4	0.0943	0.0526	-0.1108	-0.6404
6	0.0315	-0.01	-0.1725	-0.6937

CPI-Expected CPI

sigma/eta	**0.75**	**1**	**2**	**5**
2	-0.0102	-0.0145	-0.0301	-0.0699
4	-0.0223	-0.0261	-0.0403	-0.0748
6	-0.0263	-0.0301	-0.0437	-0.0763

PPI-EPT

sigma/eta	**0.75**	**1**	**2**	**5**
2	0.2921	0.2496	0.0824	-0.4675
4	0.0953	0.0526	-0.1145	-0.6544
6	0.0286	-0.0139	-0.1802	-0.7119

PPI-Expected CPI

sigma/eta	**0.75**	**1**	**2**	**5**
2	0.001	-0.0041	-0.0228	-0.0715
4	-0.0212	-0.0261	-0.0439	-0.0891
6	-0.0292	-0.034	-0.0514	-0.0952

EPT-Expected CPI

sigma/eta	**0.75**	**1**	**2**	**5**
2	-0.2894	-0.2525	-0.1051	0.3997
4	-0.1161	-0.0786	0.0709	0.5804
6	-0.0577	-0.0201	0.1302	0.6442

Ranking matrix

sigma/eta	**0.75**	**1**	**2**	**5**
2	PPI	EXP(CPI)	EXP(CPI)	EPT
4	EXP(CPI)	EXP(CPI)	EPT	EPT
6	EXP(CPI)	EXP(CPI)	EPT	EPT

Table 4b. Welfare Gaps: Financial Autarky with All Shocks and Fixed Export Price Elasticity = 5

PPI-CPI

sigma/eta	0.5	1	2	5
2	0.1813	0.1718	0.1433	0.0972
4	0.2474	0.2338	0.1933	0.1289
6	0.2811	0.2654	0.2187	0.1448

CPI-EPT

sigma/eta	0.5	1	2	5
2	2.6466	2.7702	3.256	4.7647
4	2.8418	2.9757	3.5036	5.1442
6	3.0006	3.1444	3.7151	5.5167

CPI-Expected CPI

sigma/eta	0.5	1	2	5
2	0.1133	0.106	0.0849	0.0535
4	0.1269	0.1188	0.0952	0.0596
6	0.1321	0.1237	0.0992	0.0622

PPI-EPT

sigma/eta	0.5	1	2	5
2	2.8377	2.9516	3.4088	4.8714
4	3.1187	3.2387	3.7256	5.3019
6	3.3368	3.4644	3.9877	5.7168

PPI-Expected CPI

sigma/eta	0.5	1	2	5
2	0.295	0.2782	0.2285	0.1508
4	0.3756	0.3537	0.2893	0.1889
6	0.4155	0.3911	0.3192	0.2076

EPT-Expected CPI

sigma/eta	0.5	1	2	5
2	-2.4059	-2.5242	-2.9771	-4.3012
4	-2.4372	-2.5524	-2.9888	-4.2155
6	-2.4292	-2.5395	-2.9545	-4.0926

Ranking matrix

sigma/eta	0.5	1	2	5
2	PPI	PPI	PPI	PPI
4	PPI	PPI	PPI	PPI
6	PPI	PPI	PPI	PPI

Calibration of the analytically derived Ramsey and competitive flex-price benchmarks allows us to where these welfare gaps are coming from.

All new relative to previous work!

- Under complete markets: Expected CPI delivers C and N which are both closer to those of the Ramsey's than PPI IT (hence closer viz the competitive allocation that PPI mimics).

- Under financial autarky: PPI tracks Ramsey closely and closer than expected CPI.

  →stabilizing the RER is no longer as paramount as mitigating the sticky price distortion and improving on production efficiency. PPI does that, so it wins.

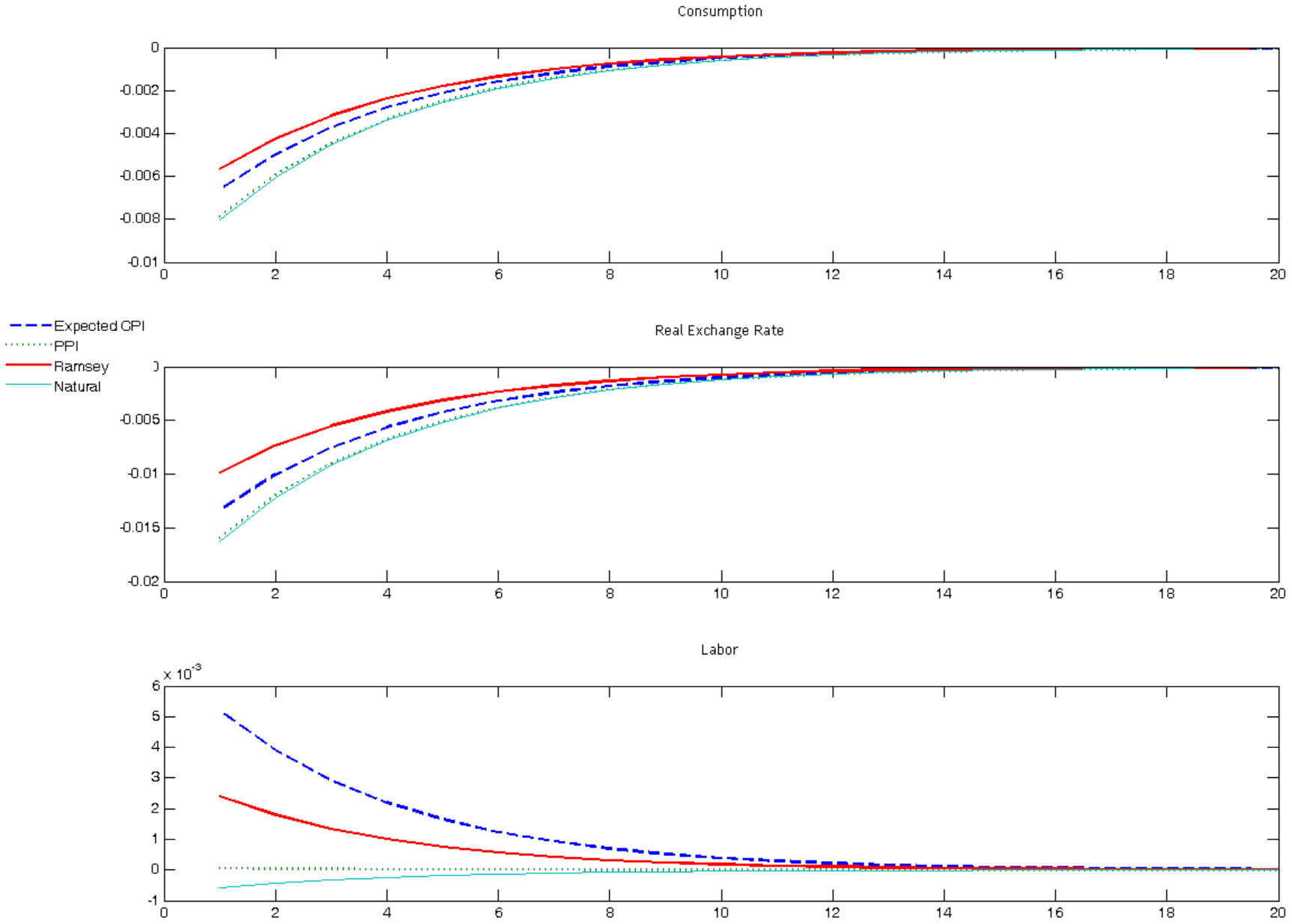

Figure 5: Responses **to Imports Price Shock**, PPI Rule Versus Expected CPI Rule, **Full Capital Mobility**

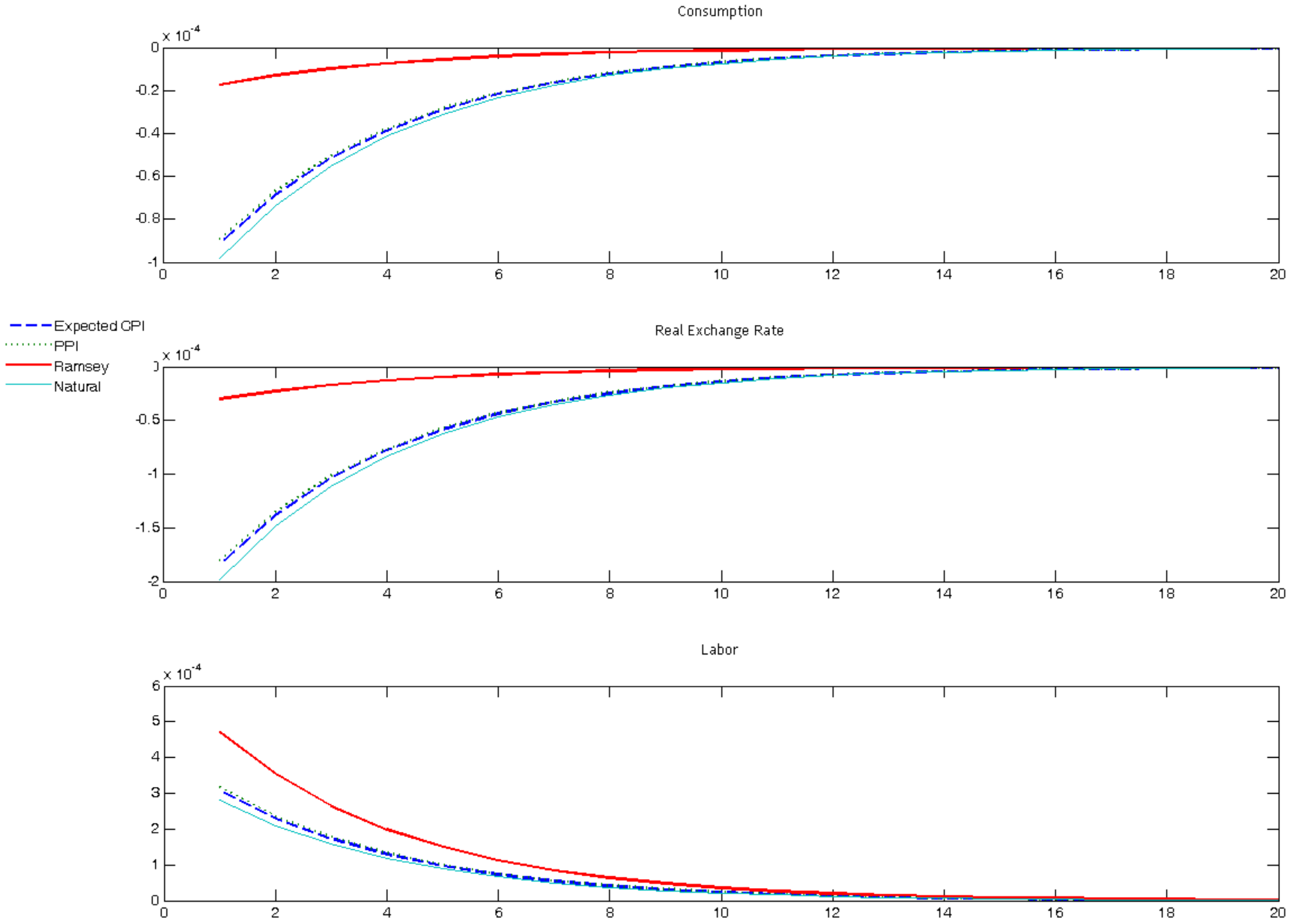

Figure 6: Responses to **Exports Price Shock**, PPI Rule Versus Expected CPI Rule, **Full Capital Mobility**

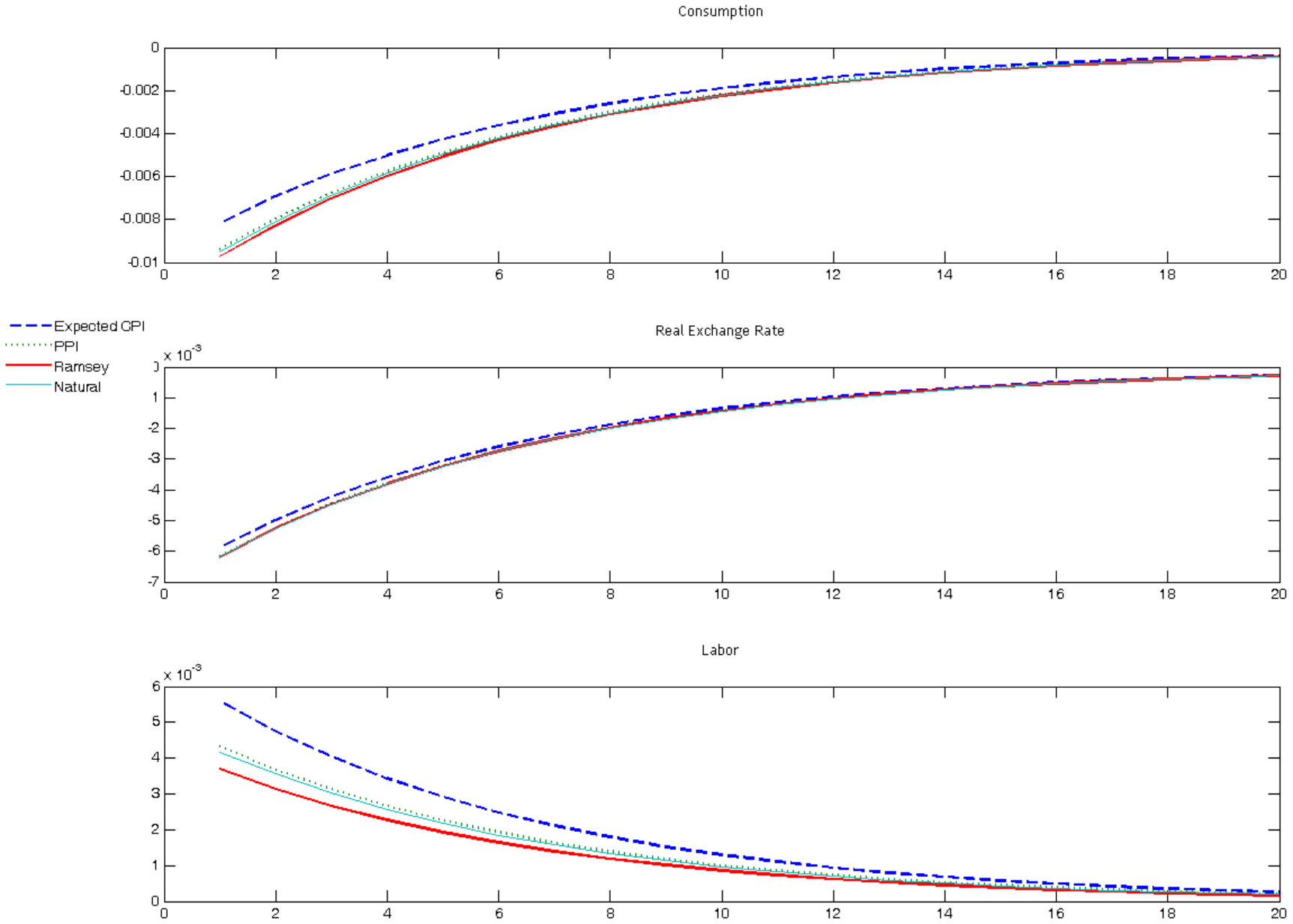

Figure 7: Responses to **Imports Price Shock**, PPI Rule Versus Expected CPI Rule, **Financial Autarky**

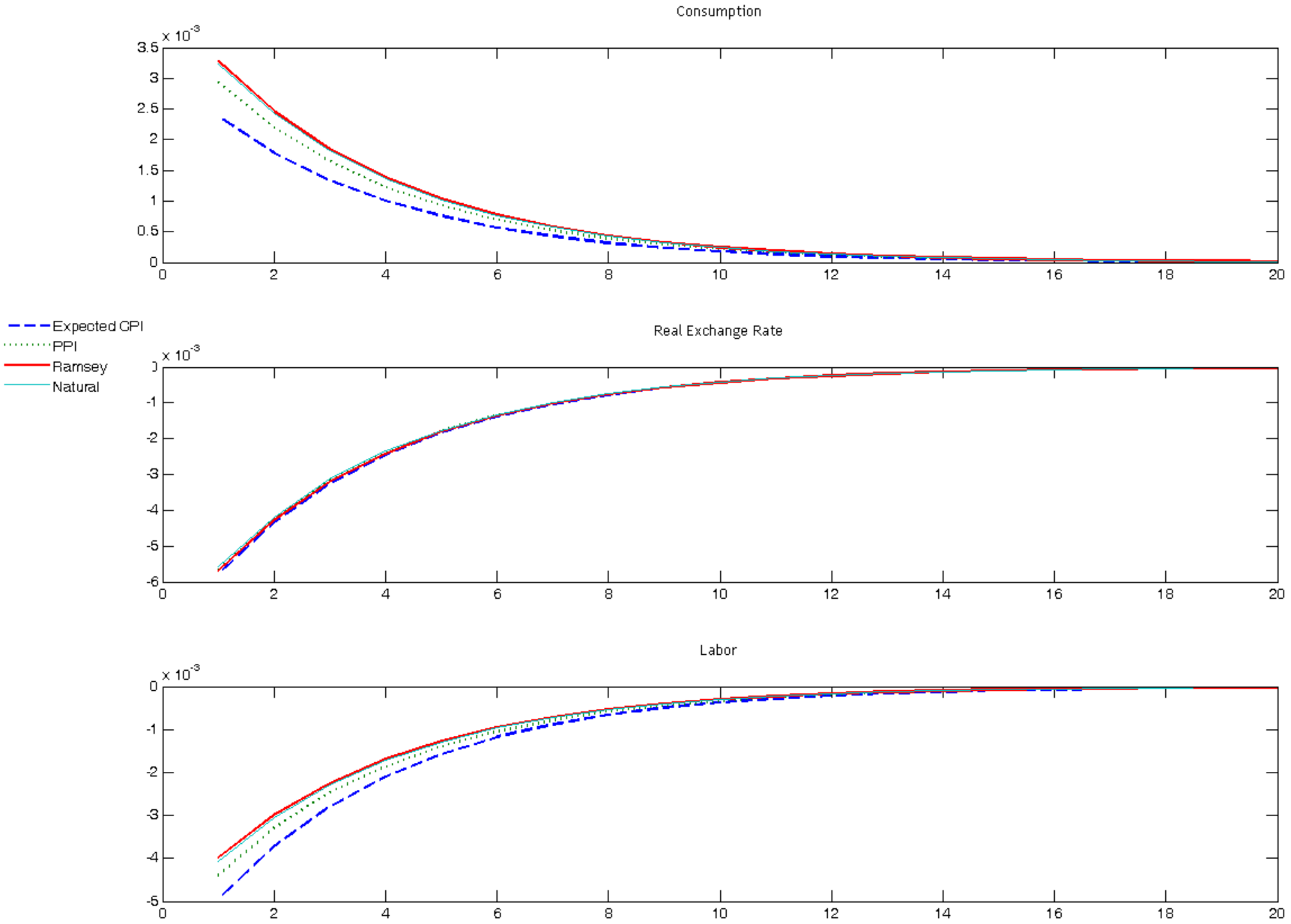

Figure 8: Responses to **Exports Price Shock**, PPI Rule Versus Expected CPI Rule, **Financial Autarky**

VII. Conclusions

Our results re-asserts part of previous findings on PPI IT welfare-dominance but also show it to be less general.

And, importantly, new derivations of Ramsey and flex-price market allocations show ***when and why*** this is so.

In particular, expected CPI targeting and export price targeting can do better than PPI under international risk sharing.

This is so when the economy specializes in home goods with a high export elasticity ($\gamma >> 1$).

That is, when the open economy is in fact small!

Indeed what is critical viz. previous work is specialization: our SOE, as in real word, neither consumes nor produces the same composite as ROW.

In particular, its CPI basket has a much high weight on commodities (e.g. food) viz. the world.

A further important difference is that shocks to commodity prices are larger and somewhat more persistent than more standard shocks like TFP and monetary shocks.

Again, this seems more consistent with real world stylized facts for many SOEs.