

INEQUALITY AND REAL EXCHANGE RATES

Narayana Kocherlakota

Luigi Pistaferri

University of Minnesota

Stanford University

Federal Reserve Bank of Minneapolis

CEPR

January 4, 2008

Abstract

Kocherlakota and Pistaferri (2007, EJ) describe two different models (Private Information Pareto Optimal and Incomplete Markets) of how households partially insure themselves against idiosyncratic shocks. They demonstrate that the models differ in terms of their implications for real exchange rates. In this paper, we use data from a wide range of countries, and document that there is a statistically significant relationship between real exchange rate growth and between-country differences in the growth rates of right-tail, but not left-tail, inequality growth. This finding is consistent with the Private Information Pareto Optimal model of partial insurance, but not the Incomplete Markets model. (JEL: F31, D30, D91)

Acknowledgments: We thank Giancarlo Corsetti, Doireann Fitzgerald and seminar participants at the 2007 EEA meeting in Budapest for comments, and Rusi Yan for able research assistance. Kocherlakota acknowledges the support of NSF 06-06695. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

Email addresses: nkocher@atlas.socsci.umn.edu (Kocherlakota); pista@stanford.edu (Pistaferri)

1. Introduction

In a classic paper, Backus and Smith (1993) prove that if asset markets are frictionless, then the growth rate of the real exchange rate should be perfectly correlated with between-country differences in per capita consumption growth. However, they also show that this implication is dramatically falsified in data on OECD countries: The correlation between the growth of the real exchange rate and between-country differences in per capita consumption growth is basically zero (or even negative in more recent periods). It follows that asset markets cannot be truly frictionless. However, what friction is actually responsible for this disconnect between theory and data is still not well understood (as argued by Chari, Kehoe, and McGrattan (2002) among others).

Here we aim toward identifying the relevant asset market friction. We build on recent work by Kocherlakota and Pistaferri (2007; hereafter KP). They show that the theoretical connection between consumption growth rates and real exchange rates relies on the assumption that there is a representative agent in each country. In particular, KP show that the connection breaks down if households within a country are only partially insured against idiosyncratic shocks such as disability, unemployment, or wage fluctuations. Instead, under partial insurance, economic theory implies that real exchange rates should be correlated with between-country differences in the growth rate of consumption *inequality*.

In this paper we make two contributions. The first is that we empirically assess this implication of KP in a large set of countries. We proceed by regressing movements in the real exchange rates for a given country pair on movements in

measures of inequality for each of the paired countries. We find that there is a statistically and economically significant connection between real exchange rate growth and the relative growth of consumption inequality.

A second contribution of the paper is that our empirical results shed light on the nature of within-country partial insurance. KP consider two different models of partial insurance. In the first, households can trade assets that pay off on aggregate but not idiosyncratic shocks; KP call this model an *incomplete markets* (IM) model of partial insurance. In the second model, households sign lifetime insurance contracts that are optimal subject to a moral hazard problem, the insurers then trade assets on the households' behalf; KP call this model a *private information Pareto optimal* (PIPO) model of partial insurance. KP establish that under the IM (resp. PIPO) model, real exchange rate growth is correlated with between-country differences in the growth of inequality as measured by the left (resp. right) tail of the consumption distribution. Our empirical results show that real exchange rate growth is correlated with changes in right-tail inequality, not left-tail inequality. Hence, we find that the PIPO model provides a better rationalization of the movements of real exchange rates.¹

There is a simple intuition for why the different models of partial insurance imply that different measures of inequality are relevant for real exchange rates. In the IM model, the limited insurance generates a *precautionary* demand for assets. This precautionary demand is especially high when agents face significant

1. KP obtain a similar finding in their structural econometric analysis of the United States–United Kingdom real exchange rate. The goal here is to generalize their findings to more than a single bilateral country pair.

amounts of downside—that is left-tail—risk. The high precautionary demand for goods in a given country puts upward pressure on the price of its particular non tradeables relative to tradeable goods that are demanded everywhere. Thus, under the IM model, an increase in a country’s left-tail inequality causes the real exchange rate to appreciate. Our empirical work shows that this implication is not borne out by the data.

In the PIPO model, however, insurance is limited because of an *incentive* problem. The degree of this incentive problem in a given country depends on the heaviness of the *right* tail of the consumption distribution. To take an extreme case, suppose one person owns practically everything in a given country. In this country, the incentive problem is relatively small; because of diminishing marginal utility of consumption, it is easy to motivate the consumption-poor (but highly skilled) agents to perform the right amount of effort. It follows that if a country’s right tail inequality increases, then the price of its non tradeables falls, because they have become cheaper to produce compared with tradeable goods that are produced elsewhere. Thus, under the incentive-based PIPO model, the real exchange rate depreciates when right-tail inequality increases. We find that this implication is borne out by the data.

The rest of the paper contains a discussion of the theoretical implications and empirical strategy (Section 2), the data (Section 3), and the results (Section 4). Our conclusions are in Section 5.

2. Real Exchange Rates and Inequality

2.1. Theoretical Implications

In this subsection, we summarize the key testable implication for real exchange rates of three different trading models: a model with a representative agent within each country (RA model), one with domestically incomplete markets (IM model), and one characterized by private information Pareto optimality (PIPO model). The discussion draws heavily upon KP, to which we refer the interested reader for technical details.

In what follows, we denote with $C_{\eta t}^j(z^t)$ the cross-sectional η th (non central) moment of consumption in country j and history z^t . If markets are domestically incomplete, then we can aggregate across individual Euler equations, and prove that, for some constant μ_{jk} ,

$$e_t^{jk}(z^t) = \frac{E[(c_t^k)^{-\gamma} \mid z^t]}{E[(c_t^j)^{-\gamma} \mid z^t]} \mu_{jk},$$

where $e_t^{jk}(z^t)$ is the real exchange rate between country j and country k . By the Law of Large Numbers, the conditional expectations are equivalent to cross-sectional moments. Hence,

$$e_t^{jk}(z^t) = \frac{C_{-\gamma t}^k(z^t)}{C_{-\gamma t}^j(z^t)} \mu_{jk}.$$

By taking logs and first differences, we derive the key implication of domestically incomplete markets for real exchange rates:

$$\Delta \ln e_t^{jk}(z^t) = \Delta \ln C_{-\gamma t}^k(z^t) - \Delta \ln C_{-\gamma t}^j(z^t), \quad (\text{IM})$$

where Δ is the first-difference operator.

In the PIPO trading model, households trade assets only through their insurers. We can use a similar aggregation trick across the Euler equations of the insurance companies to show that for some constant v_{jk} , the following restriction should hold:

$$e_t^{jk}(z^t) = \frac{E[(c_t^j)^\gamma \mid z^t]}{E[(c_t^k)^\gamma \mid z^t]} v_{jk}.$$

Using logic similar to that in the preceding paragraph, we conclude that the PIPO model implies

$$\Delta \ln e_t^{jk}(z^t) = \Delta \ln C_{\gamma t}^j(z^t) - \Delta \ln C_{\gamma t}^k(z^t). \quad (\text{PIPO})$$

Finally, one can derive the restrictions of the representative agent model. Suppose that there is only a single type of agent in each country. One can then prove that

$$\Delta \ln e_t^{jk}(z^t) = \gamma (\Delta \ln C_{\gamma t}^j(z^t) - \Delta \ln C_{\gamma t}^k(z^t)). \quad (\text{RA})$$

The growth rate of the real exchange rate is equal to the difference in growth rates of per capita real consumption multiplied by the coefficient of relative risk aversion. This formula is the same as that of Backus and Smith (1993).

As described in the Introduction, the three models differ in how consumption inequality influence the real exchange rate. In the Backus and Smith (1993) model, households are (implicitly) fully insured. Only per capita consumption enters the formula; consumption inequality is not related to real exchange rates.

In contrast, in (IM), $C_{-\gamma t}^k(z^t)$ increases when inequality driven by the left tail of the distribution increases. However, an increase in right-tail inequality leaves $C_{-\gamma t}^k(z^t)$ unchanged. The consequence is that the real exchange rate e_t^{jk} grows faster when (left-tail driven) inequality in country k grows faster relative to that

in country j .

In (PIPO), $-C_{\gamma t}^k(z^t)$ is the mean of a concave function of household consumption (at least when $\gamma > 1$, which is the empirically relevant range). This moment decreases when inequality driven by the right tail of the distribution increases, whereas an increase in inequality driven by the left tail of the distribution leaves it unchanged. Hence, the real exchange rate between country j and k grows slower when (right-tail driven) inequality in country k grows faster relative to that in country j .

2.2. Empirical Strategy

The reduced-form regression that we run to test the implications of the three models is as follows:

$$\Delta \ln e_t^{jk} = X_t^{jk} \alpha + \beta (\Delta L_t^j - \Delta L_t^k) + \delta (\Delta R_t^j - \Delta R_t^k) + \theta (\Delta \ln C_{1t}^j - \Delta \ln C_{1t}^k) + \zeta_t^{jk}, \quad (1)$$

where e_t^{jk} is the real exchange rate between country j and country k , X_t^{jk} controls for observable characteristics for the country pair jk , L_t^j is a measure of left-tail driven inequality and R_t^j a measure of right-tail driven inequality, C_{1t}^j is per capita real consumption, and ζ_t^{jk} is an error. If $\beta = \delta = 0$ and $\theta > 0$, there is evidence for the RA model. If $\beta < 0$ and $\delta = \theta = 0$, there is evidence for the IM model, whereas if $\delta > 0$ and $\beta = \theta = 0$, there is evidence for the PIPO model.²

2. We make the assumption that shocks to (or omitted determinants of) real exchange rates are orthogonal to the variables that appear in equation (1) (note that our first-difference procedure removes country-pair specific fixed effects). We also assume that within-country inequality is driven by exogenous shocks (skill-bias technology shocks, institutional changes, etc.). Future work may address

3. Data

To implement (1), one needs information on real exchange rates for a country pair jk in addition to cross-country data on inequality for j and k . We assembled data on country-specific income and consumption inequality from the World Income Inequality Database (WIID2) maintained at the United Nations University and data on the real exchange rates from the Economic Research Service at the USDA (which computes them using, for non-European countries, data from the International Financial Statistics of the IMF, and for countries participating in the EMU, from the Board of Governors of the Federal Reserve System). In the empirical analysis to follow we also use country economic data from the Penn World Tables (see Heston, Summers and Eton, 2006) as well as political instability data from Polity IV.³

The WIID2 is a data set collected by the United Nation University and the World Institute for Development Economics Research (WIDER). The data set covers about 150 countries. The sources for the inequality measures in the dif-

endogeneity issues, in particular that of inequality. For example, “globalization” shocks may simultaneously affect relative inequality across countries as well as real exchange rates. Finding instruments for cross-country differences in inequality is, of course, an open challenge.

3. The real exchange rate is defined as $e_t^{jk} = (p_k/p_j) E_t^{jk}$, where p^j and p^k are the respective consumer price indexes in countries j and k and E_t^{jk} is the nominal exchange rate—that is, the price of country k 's currency in terms of country j 's currency. For example, if j is the United States and k is the United Kingdom, E_t^{US-UK} is the price of a British pound in U.S. dollars (about 2 \$ as of August 2007). An increase in e_t^{jk} means that the dollar is depreciating in real terms.

ferent countries are central statistical offices of the countries involved as well as the Transmonee database of UNICEF/ICDC, the unit record data of the Luxembourg Income Study, the World Bank Poverty Monitoring database, the Socio-Economic database for Latin America and the Caribbeans, and various research studies (in particular, Deininger and Squire 2004). The measures of inequality included in the data set are: the Gini coefficient, quintile/decile group shares, income shares of the poorest 5% and richest 95% of the population, survey means, and medians. However, for most countries only a subset of these measures are available. For most details, see UNU-WIDER (2007). We supplement the dataset by adding consumption inequality statistics for the U.S., the U.K., and Italy, computed using the U.S. Consumer Expenditure Survey, the U.K. Family Expenditure Survey, and Italy's Household Budget Survey, respectively.

Because they come from disparate sources, the measures of inequality collected in the data set differ on a number of dimensions: variable of interest (income vs. consumption or expenditure), statistical units surveyed (individual, household, etc.), equivalence scale used (if any), and weighting scheme. The researchers involved in the collection of the data assigned quality scores (from 1 to 4, with 1 the highest quality rating) depending on to what extent the data set measures were obtained following the standard recommendations described in Canberra Group (2001) and Deaton and Zaidi (2002).⁴

We measure inequality at the bottom of the distribution (L) as (minus) the

4. The quality ratings are as follows: 1 if the survey and income concept are known and acceptable; 2 if survey or income concept are acceptable; 3 if neither the survey nor the income concept are known or acceptable; 4 if there is a memorandum item.

share going to the lowest 10%⁵ and measure inequality at the top (R) as the share going to the highest 10%. Table A.1 in the Appendix (available on request from the authors) gives ample details on the information we have available. The ideal measure of inequality emphasized by the theory above is consumption inequality. Unfortunately, very few countries collect information on consumption (or expenditure) inequality; and even when they do, the time series is fairly short. For this reason, we use income inequality data if consumption inequality data are not available. For countries with enough data on both consumption and inequality measures, we use both. To check informally whether using income inequality in the place of consumption inequality is appropriate, we consider those few countries with data on both income and consumption inequality. Figures A.1 and A.2 in the Appendix show that, for almost all countries considered, the *trends* in income inequality and consumption inequality (which is the kind of information we use in (1)) are similar even though the levels may be quite different (in general, consumption inequality is less than income inequality).⁶

We try to construct inequality series that are as homogeneous as possible. For most countries, only one record per year is available. For other countries, however, there are multiple records per year provided by multiple sources. The same source usually contributes multiple records over time. For example, for Mexico, the Luxembourg Income Study provides data for seven years between 1984 and 2002. In selecting the records for the various years, we tried to maintain

5. This is because a decrease in the share signals an increase in left-tail inequality.

6. The correlation coefficients are 0.7781 for left-tail inequality and 0.7859 for right-tail inequality.

homogeneity of the time series. For many countries we chose the series that spanned the most years.

Figures A.3 in the Appendix plot the share going to the bottom 10% against time for all countries in our data set. These graphs are informative about the levels and also the trends in left-tail inequality. For example, Brazil has persistently higher inequality than Finland. On the other hand, different countries experience different evolutions in inequality. In Argentina, Germany, and the United Kingdom, to mention just a few, left-tail inequality increases, whereas in Canada, France, and Sweden we see the opposite pattern. Most Eastern European countries experience an increase in inequality in the transition to capitalism. Other countries (Bolivia, Colombia, Finland, Italy) have less clear patterns. Figure A.4 plots the share going to the top 10% against time for all countries in our data set and thus is informative about right-tail inequality. Here, the level differences are sometimes staggering. In Brazil, the income share going to the top 10% is between 50% and 60%; in Germany this share is only about 25%. Some of the trends are also fairly clear: there is increasing inequality in countries like Israel, Sri Lanka, and Mexico, decreasing inequality in countries like France, Italy, and Malaysia, and more nuanced patterns elsewhere. Note that the cross-sectional variability is much higher in R than in L .

In principle, with N countries, one could form a maximum of $\binom{N}{2}$ bilateral real exchange rate pairs. In practice, we have much fewer than that. For a start, countries with only one observation (e.g., Azerbaijan, Bahamas) are not part of the sample used in our regression analysis because (1) requires at least two data points on inequality. Moreover, not all countries with two (or more) observations

will necessarily be matched, because their inequality data may be for different periods. For example, even though we have information on the growth in the Albania–Barbados real exchange rate for all years between 1970 and 2005, these two countries are not part of the data set used in the regression analysis because they provide inequality statistics for only two years, which are not the same years (1996 and 2002 for Albania, 1970 and 1978 for Barbados). Finally, given the form of (1), we end up discarding non independent observations on real exchange rate growth and inequality growth differentials (see Koedijk and Schotman 1990). For example, if in one year we have information on (say) Albania, Argentina and Armenia, then we retain the observation for Albania and Argentina and that for Albania and Armenia but discard the observation for Argentina and Armenia, because the real exchange rate growth for this latter pair can be obtained by linear combination of the first two, as can the variables that appear on the right-hand side. Note that, for most country pairs, both the left- and right-hand side variables are first (one-year) differences (about 45% of the sample). For other country pairs, however, data may be available only over longer frequencies. For example, Albania and Argentina are matched only in 1996 and 2002, so the left- and right-hand side variables for this country pair are actually six-year differences. The algorithm we use to discard the non independent observations accounts for this additional complication (e.g., we would not discard the observation for Argentina and Armenia here if it covered a different time span than the ones for the other two country pairs).⁷

7. Details on the algorithm used are available on request from the authors.

4. Results

In Table 1 we report the results of a number of specifications of regression (1) in order of complexity. In column (1) we have no controls. Differences in the growth of right-tail inequality have the expected sign ($\delta > 0$) and are highly statistically significant (the p -value of the one-sided test is 0.05%). In contrast, differences in the growth of left-tail inequality, while having the expected sign ($\beta < 0$), are insignificant (the p -value of the one-sided test is 33%). Finally, the difference in per capita real consumption growth rates displays a negative sign, thus confirming the Backus and Smith puzzle. The results do not change if we control for global shocks (column 2) and geographic dummies (column 3).

The literature on the determinants of real exchange rates is vast. In keeping with our reduced-form approach, we augment the basic specification to include variables that have been suggested as playing a role in explaining movements in real exchange rates. These controls are included not to test for alternative theories of real exchange rate determination, but rather to avoid the criticism that our measures of inequality are significant only because they proxy for omitted determinants of real exchange rates. We include controls for differences in GDP growth as a proxy for productivity differentials across countries (the so-called Balassa-Samuelson effect; column 4), differences in the growth of the government expenditure–GDP ratio to proxy for demand factors (Froot and Rogoff 1995; column 5), openness to international trade as a proxy for increased international integration and a decline of tariff and non tariff barriers (column 6), and differences in the degree of democracy and autocracy to control for real exchange

TABLE 1. Regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
β	-0.9546 (2.1142)	-1.0367 (2.0522)	-0.8526 (2.0475)	-1.2158 (2.0542)	0.4818 (2.0000)	0.4414 (2.0002)	1.7774 (2.1345)
δ	1.1390 (0.3382)	1.1043 (0.3270)	1.0678 (0.3263)	0.9818 (0.3205)	0.9413 (0.3066)	0.9597 (0.3075)	1.0970 (0.3318)
θ	-0.4062 (0.0642)	-0.3619 (0.0621)	-0.3573 (0.0642)	-0.2364 (0.0661)	-0.3824 (0.0692)	-0.3615 (0.0709)	-0.3952 (0.0861)
j, k both OECD			-0.0494 (0.0272)	-0.0587 (0.0266)	-0.0585 (0.0256)	-0.0611 (0.0257)	-0.0642 (0.0261)
j, k both EU			0.0383 (0.0327)	0.0407 (0.0328)	0.0310 (0.0305)	0.0322 (0.0308)	0.0194 (0.0309)
j or k Africa			0.0375 (0.0300)	0.0252 (0.0297)	0.0041 (0.0293)	0.0010 (0.0296)	-0.0392 (0.0314)
j or k former USSR			0.1484 (0.0465)	0.1579 (0.0465)	0.1575 (0.0444)	0.1545 (0.0439)	0.1943 (0.0586)
$g_{jt} - g_{kt}$				-0.0128 (0.0021)	-0.0152 (0.0021)	-0.0153 (0.0021)	-0.0173 (0.0026)
$\Delta \left(\frac{G}{Y}\right)_{jt} - \Delta \left(\frac{G}{Y}\right)_{kt}$					-0.0292 (0.0037)	-0.0288 (0.0034)	-0.0295 (0.0038)
$\Delta op_{jt} - \Delta op_{kt}$						-0.0007 (0.0007)	0.0001 (0.0008)
$\Delta Dem_{jt} - \Delta Dem_{kt}$							-0.0277 (0.0089)
$\Delta Aut_{jt} - \Delta Aut_{kt}$							-0.0394 (0.0106)
Year dummies	No	Yes	Yes	Yes	Yes	Yes	Yes
N	2,738	2,738	2,738	2,738	2,738	2,738	2,417

Note: g_{jt} is the growth rate of real GDP per capita (Laspeyres) in country j at time t . The variable op_{kt} is a measure of openness, the variable $\frac{G}{Y}$ is the public expenditure share of GDP. Standard errors are robust to heteroskedasticity of unknown form.

*See text for descriptions.

rate cycle induced by elections (Stein and Streb, 2004; column 7).⁸ In column (7) the number of observations declines because some countries do not have data on measures of political instability, but the results remain similar. If anything, they get stronger: the estimate of δ is essentially the same (with little change in its standard error) while the estimate of β remains insignificant and even turns positive —i.e., it displays the *wrong* sign. Thus, the evidence is that the PIPO model provides a better rationalization of the movements of real exchange rates than does the IM or RA model.⁹

The interpretation of these regressions is that an increase in right-tail inequality in country j relative to country k increases the price of country k 's bundle of goods in terms of a country j 's bundle of goods. That is, country j 's currency depreciates in real term (country j 's bundle of goods buy less of the country k 's bundle of goods, or the country j 's consumption basket's purchasing power falls relative to country k 's basket). The intuition is that an increase in right-tail inequality in country j relative to country k means that incentive problems become

8. The openness variable is total trade (exports plus imports) as a percentage of GDP. The democracy and autocracy variables are on a 11-point scale, with 0 the lowest score and 10 the highest. See Gurr, Jagers and Moore (1990).

9. Note that we find some evidence for a Balassa–Samuelson effect (countries with higher productivity experiencing an appreciation of their currency in real terms), as well as evidence similar to Froot and Rogoff (1995)—i.e., countries with stronger increase in government spending (over GDP), which proxies for the expenditure bias toward non traded goods, experience an appreciation in real terms of their currency. On the other hand, the effect of openness is imprecisely measured. Finally, countries with low levels of democracy/political participation are more likely to experience (or perhaps impose) real term depreciations of their currency.

TABLE 2. Sensitivity checks.

	(1)	(2)	(3)	(4)	(5)
β	1.7774 (2.1345)	0.0591 (0.0383)	6.5148 (2.5018)	6.6192 (3.0228)	-0.5129 (1.2809)
δ	1.0970 (0.3318)	0.3167 (0.1069)	1.4458 (0.3994)	0.7865 (0.4560)	1.4026 (0.3730)
θ	-0.3952 (0.0861)	-0.3994 (0.0856)	-0.4732 (0.1004)	-0.5551 (0.1346)	-0.5590 (0.1097)
N	2,417	2,417	1,502	1,546	1,951

Note: Standard errors are robust to heteroskedasticity of unknown form.

*See text for descriptions.

relatively less severe in country j than in country k . This means that goods in country j become less valuable than in country k (where it's relatively harder to provide incentives to produce). Thus, a relative increase in right-tail inequality ("the rich get richer") brings about a depreciation in real terms of the local currency.

In Table 2 we perform a number of sensitivity checks to assess the robustness of our results. For brevity, we report only the estimates of β , δ , and θ . Our specification is the same as in column (7) of Table 1 and is repeated in column (1) of Table 2 (the baseline). In column (2) we redefine L and R as the log of the bottom 10%'s and top 10%'s shares, respectively. In column (3) we restrict the sample to country pairs with high quality data on inequality measures (quality rating 1 or 2, see footnote 3). In column (4) we restrict the sample to country pairs with the

same measures of inequality (consumption or income). Finally, in column (5) we redefine L as the share going to households in the ninth decile, thereby roughly account for limited financial market participation and hence giving the IM model its best chance to explain the data on real exchange rate movements. In all cases, the conclusions remain similar to those given already (the standard error of δ in column (3) gives a borderline 4.25% p -value of the one-side test). Movements in real exchange rates appear to be driven by country differences in right-tail inequality growth in the direction predicted by the PIPO model, whereas country differences in left-tail inequality growth either play no role or go opposite to the direction predicted by the IM model. The results appear remarkably stable and robust to the inclusion of controls, changes in variable specification, and sample selection.¹⁰

5. Conclusions

International economics models predict that, if asset markets are frictionless, then the growth rate of the real exchange rate should be perfectly correlated with between-country differences in per capita consumption growth. In the data, however, this prediction is strongly rejected. As in Kocherlakota and Pistaferri (2007), we relax the assumption of frictionless asset markets and instead con-

10. The regression results in column (2) of Table 2 can be interpreted as elasticity estimates of the effect of right-tail inequality on the exchange rate. According to these estimates, a 10% increase in right-tail inequality in country j relative to country k (i.e., a 10% increase in the top 10%'s share) induces a 3% real depreciation of country j 's currency relative to country k 's currency.

sider two different models of *within-country* partial insurance. In the first model, households can trade assets that pay off on aggregate but not idiosyncratic shocks. In the second, households sign lifetime insurance contracts that are optimal subject to a moral hazard problem; the insurers then trade assets on the households' behalf. As we have argued, the two models are empirically distinguishable because they deliver different predictions regarding the role of inequality in explaining real exchange rates. In the first model, real exchange rate growth is correlated with between-country differences in the growth of inequality as measured by the left tail of the consumption distribution. In the alternative model, it is the right tail of the consumption distribution that matters. Our empirical results show that, controlling for a host of possible determinants of movements in the real exchange rate, the growth in this rate is correlated with changes in right-tail inequality, not left-tail inequality. Hence, we find that this alternative model of partial insurance provides a better rationalization of the movements of real exchange rates.

Our reduced-form results buttress the structural analysis of KP for the United States and the United Kingdom. We believe that these two papers, taken together, point international economics in an entirely new direction. First, taking account of within-country insurance imperfections is potentially important for understanding phenomena in international economics.¹¹ Second, constrained Pareto optimality seems to be a much more promising way to model these within-country insurance imperfections. We look forward to seeing these insights applied to other open questions in open economy macroeconomics.

11. See Mendoza, Quadrini, and Rios-Rull (2007) for a similar argument.

Appendix

See (<http://www.jeea.org>).

References

- [1] Backus, David, and Smith, Gregory, 1993, "Consumption and Real Exchange Rates in Dynamic Economies with Non-Traded Goods," *Journal of International Economics* 35, 297-316..
- [2] Canberra Group (2001), "Final Report and Recommendations", Ottawa 2001.
- [3] Chari, Varadarajan, Kehoe, Patrick, and McGrattan, Ellen, 2002, "Can Sticky Price Models Generate Volatile and Persistent Real Exchange Rates?" *Review of Economic Studies* 69, 533-563.
- [4] Deaton, Angus, and Salman Zaidi (2002), "Guidelines for Constructing Consumption Aggregates for Welfare Analysis", Living Standards Measurement Study Working Paper no. 135, World Bank, Washington, DC.
- [5] Deininger Klaus, and Lyn Squire (2004), "A New Data Set Measuring Income Inequality", *The World Bank Economic Review*, 10(3), J65-91.
- [6] Froot, Kenneth A., and Kenneth Rogoff (1995), "Perspectives on PPP and Long-Run Real Exchange Rates", in G. Grossman and K. Rogoff (eds.), *Handbook of International Economics*, vol. III.
- [7] Gurr, Ted R., Keith Jagers and Will H. Moore (1990), "The Transformation of the Western State: The Growth of Democracy, Autocracy, and State

Power Since 1800", *Studies in Comparative International Development* 25(1):73-108.

- [8] Heston, Alan, Robert Summers and Bettina Aten (2006), Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania.
- [9] Kocherlakota, Narayana and Luigi Pistaferri (2007), "Household Heterogeneity and Real Exchange Rates," *Economic Journal* 117, C1-25.
- [10] Koedijk, Kees G., and Peter Schotman (1990), "How to Beat the Random Walk. An Empirical Model of Real Exchange Rates", *Journal of International Economics* 29 (1990) 311-332.
- [11] Mendoza, Enrique, Vincenzo Quadrini, and Jose-Victor Rios-Rull (2007), "Financial Integration, Financial Deepness and Global Imbalances," University of Minnesota working paper.
- [12] Stein, Ernesto H. and Jorge M. Streb, (2004), "Elections and their timing of devaluations", *Journal of International Economics* 63, 119–145.
- [13] UNU-WIDER (2007), "World Income Inequality Database. User Guide and Data Sources".