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Pareto weights as wedges in two-country models ☆

David Backus [a,b,*], Chase Coleman [a], Axelle Ferriere [c], Spencer Lyon [a]

[a] Stern School of Business, New York University, United States
[b] NBER, United States
[c] European University Institute, Italy

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ABSTRACT

In models with recursive preferences, endogenous variation in Pareto weights would be interpreted as wedges from the perspective of a frictionless model with additive preferences. We describe the behavior of the relative Pareto weight in a two-country world and explore its interaction with consumption and the real exchange rate.

1. Introduction

We explore the effects of recursive preferences and risk in an otherwise standard two-country exchange economy. We focus on the behavior of the (relative) Pareto weight, which characterizes consumption allocations across countries. When preferences are additive over time and across states, as they typically are, the Pareto weight is constant in frictionless environments. But when preferences are recursive and agents consume different goods, the Pareto weight can fluctuate even in frictionless environments. This variation in the Pareto weight acts like a wedge from the perspective of an additive model. Among the potential byproducts are changes in the behavior of consumption and the exchange rate.

The natural comparison is with models that use capital market frictions to account for the anomalous features of the standard model. Baxter and Crucini (1995), Corsetti et al. (2008), Heathcote and Perri (2002), Kehoe and Perri (2002), and Kose and Yi (2003) are well-known examples. The frictions in these papers might be viewed as devices to produce variation in the Pareto weight, which is then reflected in prices and quantities. In the language of Chari et al. (2007), variations in Pareto weights would appear as wedges in the frictionless model. The question for both approaches is whether these wedges are similar to those we observe when we confront frictionless models with evidence. Ultimately we would like to

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* Corresponding author.
E-mail addresses: david.backus@nyu.edu (D. Backus), ccoleman@stern.nyu.edu (C. Coleman), axelle.ferriere@eui.eu (A. Ferriere), spencer.lyon@stern.nyu.edu (S. Lyon).

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understand how the two approaches compare, but for now we are simply trying to understand the behavior of the Pareto weight in models with recursive preferences.

We build in an obvious way on earlier work with multi-good economies by Colacito and Croce (2013, 2014), Colacito et al. (2014), Kollmann (2015), and Tretvoll (2011, 2013, 2015). We show how their models work and introduce some modest extensions. We also build on the fundamental work on recursive risk-sharing by Anderson (2005), Borovicka (2015), and Collin-Dufresne et al. (2015). These papers study one-good worlds, and in that respect are simpler than work with multi-good international models, but they lay out the mathematical structure of recursive risk-sharing problems. The last paper in the list also describes an effective computational method that we adapt to our environment.

One byproduct is a clearer picture of what drives the dynamics of the Pareto weights. In many one-good economies, Pareto weights are not stable. Eventually one agent consumes everything. One of the insights of Colacito and Croce (2013) is that home bias and imperfect substitutability between goods can produce stable processes for Pareto weights and consumption shares. That is true here, as well, but we also show how changes in risk aversion and intertemporal substitutability affect the dynamics of the Pareto weight. Relative to the additive case, increasing risk aversion or decreasing intertemporal substitution generates more persistence in the real exchange rate. Whether this persistence is welcome depends on one's view of the evidence.

Risk is a particularly interesting object in this context. Random fluctuations in the relative supply of foreign and domestic goods also affect demand—with recursive preferences—through their impact on future utility. As in many dynamic models, it is not clear how (if?) we might separate the concepts of supply and demand. A change in the conditional variance of future endowments, however, works only though the second channel; supplies (endowments) do not change. Risk affects allocations of goods through its impact on the Pareto weight without any direct impact on their supply.

All of these results are based on global numerical solutions to the Pareto problem. These solutions take much more computer time than the perturbation methods used in most related work, but they come with greater assurance that the solution is accurate even in states far from the mean of the distribution.

Notation and terminology. We use Latin letters for variables and Greek letters for parameters. Variables without time subscripts are means of logs. We use the term steady state to refer to the mean of the log of a variable. Thus steady state x refers to the mean value of $\log x_t$.

2. A recursive two-country economy

We study an exchange version of the Backus et al. (1994) two-country business cycle model. Like their model, ours has two agents (one for each country), two intermediate goods ("apples" and "bananas"), and two final goods (one for each country). Unlike theirs, ours has (i) exogenous output of intermediate goods, (ii) a unit root in productivity, (iii) recursive preferences, and (iv) stochastic volatility in productivity growth in one country. The first is for convenience. The second allows us to produce realistic asset prices. We focus on the last two, specifically their role in the fluctuations in consumption and exchange rates.

Preferences. We use the recursive preferences developed by Epstein and Zin (1989), Kreps and Porteus (1978), and Weil (1989). Utility from date t on in country j is denoted U_{jt}. We define utility recursively with the time aggregator V:

$$U_{jt} = V[c_{jt}, \mu_t(U_{jt+1})] = [(1-\beta)c_{jt}^{\rho} + \beta\mu_t(U_{jt+1})^{\rho}]^{1/\rho}, \tag{1}$$

where c_{jt} is consumption in country j and μ_t is a certainty equivalent function. The parameters are $0<\beta<1$ and $\rho \le 1$. We use the power utility certainty equivalent function,

$$\mu_t(U_{jt+1}) = \left[E_t(U_{jt+1}^{\alpha})\right]^{1/\alpha}, \tag{2}$$

where E_t is the expectation conditional on the state at date t and $\alpha \le 1$. Preferences reduce to the traditional additive case when $\alpha = \rho$.

Both V and μ are homogeneous of degree one (hd1). The two functions together have the property that if consumption is constant at c from date t on, then $U_{jt} = c$.

In standard terminology, $1/(1-\rho)$ is the intertemporal elasticity of substitution (IES) (between current consumption and the certainty equivalent of future utility) and $1-\alpha$ is risk aversion (RA) (over future utility). The terminology is somewhat misleading, because changes in ρ affect future utility, the thing over which we are risk averse. As in other multi-good settings, there is no clean separation between risk aversion and substitutability.

Technology. Each country specializes in the production of its own intermediate good, "apples" in country 1 and "bananas" in country 2. In the exchange case we study, production in country j equals its exogenous productivity:

$$y_{jt} = z_{jt}. \tag{3}$$

Intermediate goods can be used in either country. The resource constraints are

$$a_{1t} + a_{2t} = y_{1t} \tag{4}$$

$$b_{1t} + b_{2t} = y_{2t}, \tag{5}$$