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Global Demand for Basket-Backed Stablecoins

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Abstract

We develop a model where persistent trade shocks create demand for a basket-backed stablecoin, such as Mark Carney's "synthetic hegemonic currency" or Facebook's recent proposal for Libra. In numerical simulations, we find four main results. First, because of general equilibrium effects of the basket currency on the volatility of currency values, overall demand for that currency is small. Second, despite scant holdings of the basket, its global reach may contribute to substantial increases in welfare if the basket is widely accepted, allowing it to complement holdings of sovereign currencies. Third, we calculate the welfare maximizing composition of the basket, finding that optimal weights depend on the pattern of international acceptance, but that basket composition does not significantly affect welfare. Fourth, despite potential welfare improvements, low demand for the basket currency from buyers limits sellers' incentives to invest in accepting it, suggesting that fears of a so-called global stablecoin replacing domestic sovereign currencies may be overstated.

Keywords: Digital Currencies, International Monetary System, Money Demand, Stablecoins

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1 Introduction

Since the Second World War, the US dollar has dominated international trade and financial markets (Eichengreen, Mehl, and Chitu 2018). As we march into a new decade, some have begun to call for an end to that dominance, suggesting that a multipolar world may be better served by a multipolar international monetary system with a multipolar reserve currency. Meanwhile, the extant dollar payment system faces new potential competition in the form of digital currencies based on emerging technologies, such as blockchain, which promise ease of access and lower transactions costs.

A growing category of competitors – dubbed "stablecoins" – employ various mechanisms to maintain stable values relative to some peg. While most stablecoins are pegged to the US dollar or other single sovereign currency, two proposals in the summer of 2019 called for the creation of new international currencies comprising a basket of sovereign currencies: Facebook announced plans for a new global currency, the Libra stablecoin (Libra Association 2019); and Mark Carney, Governor of the Bank of England, suggested exploring the creation of a "synthetic hegemonic currency" (Carney 2019).[1] One possible goal of building a payment instrument on a basket of underlying sovereign currencies is to increase global acceptance by limiting fluctuations in the value of the basket relative to any given currency.

Policy makers from around the world have questions and concerns about stablecoins ranging from privacy and fraud prevention to broader effects for financial stability and monetary policy.[2] But a simpler question arises: does a basket currency actually provide substantial value relative to the current system? Under what conditions is there a transaction role for a basket-backed currency? This paper constructs a micro-founded, international monetary model to investigate these questions.

We model a two-country, two-currency economy where agents demand currency to facilitate decentralized exchange subject to search and matching frictions. Trade shocks – fluctuations in the probability of international trade opportunities – affect money demand, leading to variations in the value of each currency. These fluctuations detrimentally affect risk averse consumers' welfare, leading to a demand for a more stable means of payment. Hence, we introduce a basket currency that is a convex combination of the two countries' currencies, which may be more stable than the constituent currencies, and analyze demand for this basket currency.

A large literature studies the potential for new currencies. These often focus on the network externalities inherent to the two-sided nature of payment systems – sellers' incentive

[1] While the IMF's Special Drawing Right had hoped to fill this role, it has failed to gain prominence over its more than forty year lifespan.

[2] For a fairly comprehensive review, see G7 Working Group on Stablecoins (2019).

to accept a currency depends on consumers' currency holdings and vice versa. In order to focus on *demand*, we abstract from this for most of our analysis, considering various exogenous scenarios for sellers' acceptance decisions. Our motivation for this is twofold. First, many technology companies already possess large user networks that make the question of acceptance less pressing. Second, as in all models of money, one equilibrium features zero adoption of the currency. Thus, we focus on obtaining upper bounds on demand, and so make generous assumptions about its acceptability.[3] In the same spirit, our model makes other generous assumptions: the basket is perfectly safe as it is fully backed by the underlying currencies, is costless to create and fully redeemable each period, and faces no threat of theft, illicit use, or other drawbacks.

The model focuses closely on the basket component of the purposed currency. Hence, the model is stylized, limited to the most parsimonious general equilibrium micro-founded model of money that can allow for meaningful consideration of a basket currency. The model divides the motive to hold a currency into two components: how often a buyer can use the currency in trade, its "spendability," and the stability of a currency, its "insurance" value. Careful treatment of both the micro-foundations of demand for currency and its general equilibrium effects are key to our ultimate conclusion, which is that, under the generous assumptions outlined above, there is minimal demand for a basket currency. We show that this result is due to the fact that basket demand varies with the level of trade, leading to higher volatility of the component currencies and decreasing welfare. Thus, the benefit of insuring against fluctuations in the value of one or both currencies is reduced when the basket itself affects such fluctuations. Overall, our model shows that the more volatile is demand for the basket currency, the more volatile will be demand for the component currencies, reducing the welfare gains from holding the basket and making it infeasible for the basket to become the globally dominant currency in equilibrium.

Although the basket currency will never dominate the sovereign currencies it comprises, we find that there can be substantial gains in world welfare if many sellers accept the basket as payment. In this case, the spendability of the basket is always high leading buyers to demand it in all states of the world. This stable demand feeds back to stabilize the more volatile sovereign currency. In turn, buyers demand more of this stabilized sovereign currency, increasing trade when it can be used.

Finally, we use the model to compute the optimal composition of the basket. Comparing the welfare implications in partial and general equilibrium, we find that conclusions about the optimal basket composition vary drastically when considering the cases in which one country's sellers accept the basket or both countries' sellers do. When only sellers from

[3] We consider sellers' incentives to accept in a penultimate section.

the country with a volatile currency accept the basket, the optimal basket composition is approximately 60-40 in favor of that country's currency, weighing the demand channel which favors pegging to stable currency against general equilibrium effects of the basket which reduce volatility of the more volatile currency. But when the basket is accepted worldwide, the general equilibrium effect dominates, and a utilitarian social planner would choose to peg to the more volatile currency, reducing this volatility in equilibrium.

Even under optimal basket weights, buyers' demand for the basket currency is only a small fraction of global currency holdings in all the scenarios we consider. Because holdings are small, so are purchases financed with the basket. This, in turn, means that sellers' profits from basket sales are low, and their willingness to pay to accept the basket is small, less than $115, even when high seller acceptance generates the highest demand among the scenarios we consider. As a point of comparison, this is far less than the cost of many point of sale terminals capable of processing current electronic payments. Hence, our model suggests low adoption, so the potential welfare gains mentioned above may not be realized.

2 Literature

We base our modelling on Zhang (2014), who studies a multi-country, multi-currency model of international trade. Building on a model of endogenous acceptance due to Lester, Postlewaite, and Wright (2012), Zhang (2014) carefully analyzes the forces driving the emergence of an internationally accepted currency, and contributes to a long standing literature on international currencies starting with Matsuyama, Kiyotaki, and Matsui (1993), as further developed by Trejos and Wright (1996), Zhou (1997), Wright and Trejos (2001), and Trejos (2004). Those earlier papers of international currencies are based on search-theoretic models of money, either on Kiyotaki and Wright (1989) or Trejos and Wright (1995) which feature indivisible money and, in the former case, indivisible goods. Instead, Zhang (2014) follows the now-standard workhorse monetary model of Lagos and Wright (2005), allowing for both divisible goods and divisible money. This allows her to give meaningful consideration to, inter alia, the strategic interaction of central banks' monetary policy. In the current study, both margins of divisibility are key to making basket currencies meaningful: without endogenous prices allowed for by divisible goods, there can be no price variation driving demand for a less volatile currency; without divisible currencies, a basket currency cannot meaningfully comprise fractions of sovereign currencies.

We expand on the steady-state model of Zhang (2014) by introducing trade shocks and a basket currency. Trade shocks allow for inflation and exchange rate volatility with a minimal departure from Lagos and Wright (2005). This, in turn, drives risk averse consumers' demand for a less volatile medium of exchange – the basket currency. We believe we are the first to study this particular sort of aggregate shock in such a framework, but a number of papers have considered different kinds of aggregate shocks in the new monetarist framework, especially technology shocks and money-growth shocks in the business cycle traditions of Kydland and Prescott (1982), Prescott (1986), and Cooley and Hansen (1995). These include Aruoba (2011), who performs a classic real business cycle calibration exercise in the new monetarist framework, Telyukova and Visschers (2013), who additionally consider idiosyncratic preference shocks showing that they are important for quantitative money demand, and Wang and Shi (2006) who allow for endogenous search effort in the goods market as well as search in the labor market. In particular, this endogenous search margin resembles our exogenous trade shocks, in that meeting probabilities vary from period to period, but with a different focus; Wang and Shi (2006) seek to explain the volatility of money velocity in a closed economy model. Another related model is that of Gomis-Porqueras, Kam, and Lee (2013) who consider exchange rate dynamics in an international Lagos and Wright (2005) model, but they have no meaningful notion of international currencies because all international exchange happens in frictionless markets – the medium of exchange motive only applies to domestic trade in the domestic currency.

Related to our notion of "insurance" value of currency, several papers have considered preferences for more stable currencies. These include Camera, Craig, and Waller (2004) and Craig and Waller (2004). But while, in these studies, a currency's stability derives from exogenous shocks (e.g. one currency suffers from exogenous misappropriation), our study derives variations in money demand from shocks to the underlying trading process. The same authors provide a further review of the early literature on international currencies in money search models (Craig and Waller 2000). See Giovannini and Turtelboom (1992) for an earlier review of the broader literature on currency substitution.

3 Environment

The model adds trade shocks and a basket currency to Zhang (2014), which is itself a two-country, two-currency extension of Rocheteau and Wright (2005). Time is discrete, and each period consists of two sub-periods: a decentralized market (DM) and a centralized market (CM).

There are two countries, home (H) and foreign (F), with populations 2 and $2n$, respectively, where $n \in (0, 1)$. Each country has its own DM in which buyers and sellers trade. There is an equal number of buyers and sellers in each country. Buyers receive utility $u(q)$ from consuming a quantity q of the good produced by sellers in the DM, but cannot produce it themselves. Sellers can produce this good at a cost $c(q)$, but do not want to consume it. Sellers are immobile, but buyers may travel to meet sellers from the other country. Meetings in each DM take place stochastically and are described in detail below. In a meeting, terms of trade are settled according to proportional (Kalai) bargaining with η being the buyer's bargaining power.

In the CM, trade occurs in a Walrasian market where agents linearly produce a numeraire good, x, one-for-one with labor, h. We assume period utility for buyers and sellers, respectively, is given by

$$\mathcal{U}^B = u(q) + U(x) - h$$
$$\mathcal{U}^S = -c(q) + U(x) - h$$

symmetrically across countries. We assume U, u, and c satisfy standard assumptions. Agents discount the future with factor $\beta \in (0,1)$.

In the DM, some buyers may leave their domestic market to trade with sellers from the other country. The probability of travelling depends on the state of the world which is realized at the beginning of the DM. There are two states, trade (T) and no-trade (N), and the state evolves according to a first-order Markov process with ρ_s being the probability that the state remains s if it was s in the previous period, $s \in \{T, N\}$. Let α_s be the probability that a buyer does not travel with $\alpha_N = 1$ and $\alpha_T = \bar{\alpha} \in (0,1)$.

Trade in the DM is subject to search frictions. The number of meetings in state $s \in \{T, N\}$ in country $i \in \{H, F\}$ is given by $\mathcal{M}_s^i = \frac{\mathcal{B}_s^i \mathcal{S}_s^i}{\mathcal{B}_s^i + \mathcal{S}_s^i}$, where $\mathcal{B}_s^i$ is the mass of buyers in the DM in country i and $\mathcal{S}_s^i$ is the mass of sellers there. In country H, $\mathcal{S}_s^H = 1$ and $\mathcal{B}_s^H = \alpha_s + (1-\alpha_s)n$, which comprises the number of home buyers who do not travel, α_s, and the number of foreign buyers who do, $(1-\alpha_s)n$. Similarly, in country F, $\mathcal{S}_s^F = n$ and $\mathcal{B}_s^F = \alpha_s n + 1 - \alpha_s$. Given the number of meetings, buyers and sellers match randomly so a buyer in country i and state s matches with probability $\mu_s^i = \mathcal{M}_s^i / \mathcal{B}_s^i$, while the probability for a seller is $\nu_s^i = \mathcal{M}_s^i / \mathcal{S}_s^i$.

We assume that agents lack commitment and trading is anonymous, so a medium of exchange is necessary for trade to occur in the DM. The government in each country issues an aggregate quantity M_i of its own fiat currency; we write $m_i \in \mathbb{R}_+$ for individual holdings. Let ϕ_s^i be the CM price of currency i in units of the CM good in state s. Market clearing in the CM implies that agents can trade currencies at the nominal exchange rate $e_s = \phi_s^H / \phi_s^F$. Independently of the state, money supplies in the two countries grow at the same rate, $\gamma = M_i^+ / M_i$, where $+$ denotes next-period variables. Money growth is implemented through lump-sum taxes or transfers of domestic currency to domestic buyers in the CM.

In addition to sovereign currencies, we assume that there exists a basket currency, and L will be used to denote quantities pertaining to the basket currency. The basket currency is elastically supplied in the CM by a technology which combines a fixed basket of the two sovereign currencies and returns a unit of of the basket currency. Let κ be the proportion of the home currency in the basket currency, so that combining κ nominal units of home currency with $1-\kappa$ nominal units of foreign currency produces 1 unit of the basket currency. In the following CM, last period's outstanding basket currency is redeemed for the underlying basket. This ensures that the value of a unit of the basket currency in the CM is given by a convex combination of the value of the underlying: $\phi_s^L = \kappa\phi_s^H + (1-\kappa)\phi_s^F$.

In addition to risk over whether they travel, and the probability of meeting, buyers face risk over what currencies sellers accept. Generically, write θ_J^i for the probability that a seller in country i accepts the set of currencies $J \in 2^{\{H,F,L\}}$. We assume all sellers in a country always accept that country's domestic currency, so $\theta_J^i = 0$ if $i \notin J$. Further, we assume there exists a government sector comprising some proportion of sellers in each country, and that these government sellers only accept their domestic sovereign currency. Hence, $\theta_{\{i\}}^i > 0$ for $i \in \{H, F\}$. We will take these probabilities as exogenous, but consider the incentives of private sector sellers to invest in accepting currencies other than their domestic one in section 7.

In summary, timing in the model is as follows. At the beginning of each period, nature draws the state of trade. Then, the DM opens, buyers may travel, agents meet bilaterally and randomly in each country's market, terms of trade are determined – limited by a buyer's money holding and the set of currencies a seller accepts – and trade occurs. Next, the CM opens, agents' old basket currency is redeemed, agents work to produce the numeraire which they trade for currency, including newly minted basket currency, and then consume.

4 Discussion of the Model

We now provide some discussion of our assumptions on the environment before proceeding to the solution of the model. First, our choice to study trade shocks allows us to highlight the key motivation driving money demand in micro-founded models: spendability. Because decentralized, anonymous[4] trade drives currency demand, changes in the rate at which decentralized meetings take place is the most natural margin to focus on when trying to understand when certain assets will be held as money. Second, for there to exist an insurance motive to hold the basket currency in this model, trade shocks must be persistent and realized at

[4]Here, we mean anonymous in the sense that buyers and sellers lack recourse to support credit, as opposed to issues of anonymity or pseudo-anonymity associated with various electronic currencies.

the beginning of the DM. If trade shocks were not persistent, they would not have an effect on currency values (which are inherently forward looking). If trade shocks were realized in the CM, quasi-linearity would induce risk neutrality, eliminating the insurance motive. To the best of our knowledge, this paper is the first to introduce persistent trade shocks in a money search framework. Third, we assume that these shocks are symmetric, in the sense that residents of both countries trade less with one another in the no trade state, and more with one another in the trade state, for parsimony. In addition, as we think of negative trade shocks representing trade wars, which tend to be bilateral, we believe that the symmetric shocks are a good starting point, with at least qualitative empirical validity.

Second, our assumption that the two trading partners are of different sizes ($n < 1$) is necessary for trade shocks to have heterogeneous effects in the two countries, leading to demand for a more stable asset as insurance. When countries are identical, fluctuations in the level of international trade lead to equal relative currency demand, so no relative volatility. Instead, when one country is smaller than the other, a small change in currency demand by buyers in the larger country will have large effects on the smaller country's aggregate currency demand. Thus, the purchasing power of one country fluctuates more than the other only when they are different sizes. This drives demand for the basket currency, as it provides insurance against the differential effects on the two currencies across states.

Third, we assume that money growth is identical in the two countries. From a technical standpoint, we need to have equal money supply growth across the two sovereign currencies to support the existence of a stationary equilibrium. This is because we assume that the basket currency has a fixed nominal composition. Thus, if the money supply of one currency were to grow faster than the other, the basket would, in real terms, converge to be comprised of 100% of the currency with the lower long-run growth rate.[5] While equal money growth is required for technical reasons, we believe it is not an unreasonable assumption. Indeed, the majority of OECD central banks have adopted, either explicitly or implicitly, a two-percent inflation target, which coincides with our assumption of equal long-run growth rates in money. Beyond technical or realism grounds, restricting to equal growth rates helps focus our analysis. Imposing equal growth rates removes simple rate of return dominance as a motivation in currency portfolios, allowing us to focus on the role of the basket *per se* in demand for the basket currency, instead of on other, well understood motives like rate of return dominance. Finally, while questions regarding optimal dynamic monetary policies, the effects of rebalancing the basket, and their interaction are interesting, they are beyond the scope of our analysis.

[5]Without a basket currency, this assumption would not be necessary, see Zhang (2014).

5 Model Solution

We look for a symmetric (within country) Markov equilibrium in real values. That is, one where real balances, quantities, etc. depend only on agents' national identity and the trade state, and not on time. Except for the uncertainty introduced by trade shocks, and the effects of the basket currency on market clearing conditions, the value functions and first order conditions of our model are standard.

5.1 CM Value Functions

Sellers in the CM have no use for currency in the DM, so simply liquidate their holdings for the general consumption good, x. Buyers work to consume and to acquire money to carry into the next DM. The value for a buyer from country $i \in \{H, F\}$ entering the centralized market is given by $W^i(\mathbf{m}, s)$, where $s \in \{N, T\}$ is the state and $\mathbf{m} \equiv (m_H, m_F, m_L)$ is the buyer's portfolio carried from the previous period.

$$W^i(\mathbf{m}, s) = \max_{x,h,\mathbf{m}^+ \in \mathbb{R}^3_+} \left\{ U(x) - h + \beta \mathbb{E}_{s^+} \left[V^i(\mathbf{m}^+, s^+) | s \right] \right\}$$

$$s.t.\;\; x + \phi_s^H m_H^+ + \phi_s^F m_F^+ + \phi_s^L m_L^+ = h + \phi_s^H (m_H + \kappa m_L) + \phi_s^F (m_F + (1-\kappa) m_L) + T_H$$

where the tax or transfer is given by $T_H = (\gamma - 1)\phi^H M^H$, $+$ denotes next period values, $\mathbb{E}_{s^+}[\cdot|s]$ denotes the expectation over the state at the beginning of next period and therefore in the next DM, and V^i is the buyer's value entering the DM. Notice, in the budget constraint, old basket currency is redeemed for its components so that m_L becomes κm_L units of home currency and $(1-\kappa)m_L$ units of foreign currency.

Substituting out h from the budget constraint and differentiating yields first order conditions: demand for CM good is such that $U'(x^*) = 1$, and buyers' demand for currency $j \in \{H, F, L\}$ solves

$$-\phi_s^j + \beta \mathbb{E}_{s^+} \left[\left. \frac{\partial V^i(\mathbf{m}^+, s^+)}{\partial m_j^+} \right| s \right] \leq 0, \quad m_j^+ \geq 0 \quad \text{comp. slack.} \tag{1}$$

The envelope conditions are

$$\frac{\partial W^i(\mathbf{m}, s)}{\partial m_j} = \phi_s^j$$

for $j \in \{H, F, L\}$ where we have used the price condition for the basket,

$$\phi_s^L = \kappa \phi_s^H + (1-\kappa)\phi_s^F.$$

Note, these envelope conditions imply that W^i is linear in $\mathbf{m}$, a consequence of quasilinear preferences which is standard in these models and has the result that agents' portfolios leaving the CM are independent of the portfolio they entered with, hence obviating the need to keep track of distributions of money holdings which result from the search process in the DM.

5.2 DM Terms of Trade

In the DM, we assume anonymity and a lack of commitment, so necessitating a medium of exchange. Moreover, while buyers' money holdings are unrestricted, we assume sellers have an exogenous type dictating which currencies they can accept in trade. In particular, if a buyer holding the vector (m_H, m_F, m_L) of the three currencies meets a seller who accepts only the subset J, then the total value that can be transferred is limited to $\sum_{j\in J} \phi_s^j m_j$ where ϕ_s^j is the value in the next CM of currency j when the state is $s \in \{T, N\}$. Note, buyers are indifferent over which currencies to transfer because of linearity of buyers' CM value functions combined with the Walrasian CM market which guarantees that buyers and sellers value money equally in the CM.

Given this bound on transfers, terms of trade are set according to proportional (Kalai) bargaining, with the buyer's bargaining power given by $\eta \in (0, 1)$. Using the linearity of the CM value function, the bargaining problem between a buyer holding $\mathbf{m}$ and a seller accepting currencies J in state s is

$$\max_{q,d} u(q) - d$$

$$\text{s.t.} \sum_{j\in J} \phi_s^j m_j \geq d = (1-\eta)u(q) + \eta c(q)$$

Write $g(q) = (1-\eta)u(q) + \eta c(q)$ for the transfer required to purchase q units, and set q^* to solve $u'(q^*) = c'(q^*)$. Then the bargaining solution is

$$(q(\mathbf{m}, s, J), d(\mathbf{m}, s, J)) = \begin{cases} (q^*, g(q^*)) & \text{if } g(q^*) < \sum_{j\in J} \phi_s^j m_j \\ (h(\sum_{j\in J} \phi_s^j m_j), \sum_{j\in J} \phi_s^j m_j) & \text{otherwise} \end{cases}$$

where we define $h(d) \equiv \min\{g^{-1}(d), q^*\}$ to be the quantity that would be purchased given d units of transferable value.

In words, if the efficient trade is affordable, it is executed with the transfer given by g, otherwise all acceptable currencies are transferred and the quantity is given by g^{-1}. Note, this solution implies that buyers' surplus from a meeting can be written as

$$u(q(\mathbf{m},s,J)) - d(\mathbf{m},s,J) = \eta S(q(\mathbf{m},s,J))$$

where $S(q) = u(q) - c(q)$ is the surplus from trading a quantity q (hence the name, "proportional bargaining").

In a given meeting, the marginal value to a buyer of an extra (CM consumption good) unit of currency j is

$$\begin{aligned} L_j(q(\mathbf{m},s,J)) &\equiv \frac{\partial}{\partial \phi_s^j m_j} \eta S(q(\mathbf{m},s,J)) \\ &= \eta S'(q(\mathbf{m},s,J))(g^{-1})'(g(q(\mathbf{m},s,J))) \\ &= \frac{\eta[u'(q(\mathbf{m},s,J)) - c'(q(\mathbf{m},s,J))]}{\eta u'(q(\mathbf{m},s,J)) + (1-\eta)c'(q(\mathbf{m},s,J))} \end{aligned} \tag{2}$$

if $j \in J$, and $L_j(q(m,s,J) = 0$ otherwise. This expression gives the liquidity premium on money, and will be used below.

5.3 DM Value Functions

Given the terms of trade described above, and using linearity of the CM value, buyers' value functions entering the DM can be written as

$$\begin{aligned} V^i(\mathbf{m},s) = W^i(\mathbf{m},s) + \alpha_s \mu_s^i \sum_{J \in 2^{\{H,F,L\}}} \theta_J^i \eta S(q(\mathbf{m},s,J)) \\ + (1-\alpha_s)\mu_s^{-i} \sum_{J \in 2^{\{H,F,L\}}} \theta_J^{-i} \eta S(q(\mathbf{m},s,J)) \end{aligned}$$

where $-i \neq i$ is the opposite country. The first term is the value of continuing to the CM, the second is the probability of not travelling and being matched to a seller accepting currencies in J times the surplus thereof, while the third is the same but for travelling.

Envelope conditions are given by

$$\frac{\partial}{\partial m_j} V^i(\mathbf{m},s) = \phi_s^j[1 + \tilde{\Lambda}_j^i(\mathbf{m},s)] \tag{3}$$

where

$$\tilde{\Lambda}^i_j(\mathbf{m}, s) = \alpha_s \mu^i_s \sum_J \theta^i_J L_j \left(h \left(\sum_{j \in J} \phi^j_s m_j \right) \right) \mathbf{1}_{j \in J}$$
$$+ (1 - \alpha_s) \mu^{-i}_s \sum_J \theta^{-i}_J L_j \left(h \left(\sum_{j \in J} \phi^j_s m_j \right) \right) \mathbf{1}_{j \in J}$$

where $\mathbf{1}_{j \in J}$ is an indicator of whether currency j is accepted and L_j is given in equation (2), above.

5.4 Money Demand and CM Market Clearing

To obtain money demand, substitute the DM envelope conditions (3) into the CM first order conditions (1) to obtain

$$-\phi^j_s + \beta \left[\rho_s \phi^{j+}_s [1 + \tilde{\Lambda}^i_j(\mathbf{m}, s)] + (1 - \rho_s) \phi^{j+}_{-s} [1 + \tilde{\Lambda}^i_j(\mathbf{m}, -s)] \right] \leq 0. \tag{4}$$

Buyers must choose money holdings in the CM before the state in the next DM is realized. Hence, a nominal quantity of currency j, m_j, purchased in state s in the current CM will have a value in the next CM (so also in exchange in the next DM) of either $\phi^{j+}_N m_{j,s}$ or $\phi^{j+}_T m_{j,s}$. Given our Markovian assumption, if the state does not change, then real balances must be constant. Thus, market clearing will imply $\phi^j_s = \gamma \phi^{j+}_s$. If, however, the state changes from one period to the next, the real value of a given portfolio will change. Hence, write $\zeta_j = \phi^j_T / \phi^j_N$ for the ratio in value of a currency j from the N state to the T state.

Next, notice that m_j only appears in $\tilde{\Lambda}^i_j$ in terms of its real value, $\phi^j_s m_j$. So, writing $z^i_{j,s} = \phi^j_s m^i_j$ for real balances of currency j in state s held by buyers from i, and $\mathbf{z}^i_s$ as the vector of such, define $\Lambda^i_j(\mathbf{z}^i_s, s) = \tilde{\Lambda}^i_j(\mathbf{m}, s)$.

Putting these together, we can obtain first order conditions for real balances of currency j in the two states:

$$-\frac{\gamma}{\beta} + \rho_N [1 + \Lambda^i_j((z^i_H, z^i_F, z^i_L), N)] + (1 - \rho_N) \zeta_j [1 + \Lambda^i_j((\zeta_H z^i_H, \zeta_F z^i_F, \zeta_L z^i_L), T)] \leq 0. \tag{5}$$

and

$$-\frac{\gamma}{\beta} + \rho_T [1 + \Lambda^i_j((z^i_H, z^i_F, z^i_L), T)] + (1 - \rho_T) \zeta^{-1}_j [1 + \Lambda^i_j((\zeta^{-1}_H z^i_H, \zeta^{-1}_F z^i_F, \zeta^{-1}_L z^i_L), N)] \leq 0. \tag{6}$$

These equations are the heart of the model, so warrant some discussion. When contemplating which of several currencies to carry, a buyer prefers currencies that hold their value. In the no-trade state, currencies with higher ζ are preferred, all else equal, while in the trade state, currencies with lower ζ are preferred. We refer to this motive of currency selection as the "insurance" motive to hold a currency. Here, all else equal refers to the liquidity value of the currency, Λ^i_j. This, in turn, depends mostly on the probability of being able to spend a given currency, as, when two currencies are accepted, they are perfect substitutes because both the buyer and seller agree on their value in meetings where two currencies are accepted. This latter motive, based on the probability of meeting a seller who accepts a given currency, we refer to as the "spendability" motive to hold a currency.

We now turn to the market clearing conditions. The demand for a given sovereign currency comprises the direct demand from buyers in each country in each state, $z^i_{j,s}$, and the indirect demand derived from the basket currency: κ for the home currency and $(1-\kappa)$ for the foreign. To convert the real holdings of the basket currency into the indirect demand from the underlying currencies, one must adjust by the ratio of price levels. So, aggregate demand for real holdings of the basket, $z^H_{L,s} + nz^F_{L,s}$, yields indirect demand for the home currency of $\kappa\phi^H_s(z^H_{L,s}+nz^F_{L,s})/[\kappa\phi^H_s+(1-\kappa)\phi^F_s]$ and $(1-\kappa)\phi^F_s(z^H_{L,s}+nz^F_{L,s})/[\kappa\phi^H_s+(1-\kappa)\phi^F_s]$ of indirect demand for the foreign currency. Hence, the market clearing condition for the home currency, e.g., is

$$\begin{aligned}\phi^H_s M_H &= z^H_{H,s} + nz^F_{H,s} + \kappa\frac{\phi^H_s(z^H_{L,s}+nz^F_{L,s})}{\kappa\phi^H_s + (1-\kappa)\phi^F_s} \\ &= z^H_{H,s} + nz^F_{H,s} + \frac{\kappa e_s}{\kappa e_s + (1-\kappa)}[z^H_{L,s} + nz^F_{L,s}]\end{aligned} \tag{7}$$

where we have substituted the exchange rate in each period, $e_s = \phi^H_s/\phi^F_s$. Writing $\chi = M^H/M^F$ for the ratio of nominal stocks of currency, one derives

$$\chi e_s = \frac{\phi^H_s M_H}{\phi^F_s M_F} = \frac{z^H_{H,s} + nz^F_{H,s} + \frac{\kappa e_s}{\kappa e_s+(1-\kappa)}[z^H_{L,s}+nz^F_{L,s}]}{z^H_{F,s} + nz^F_{F,s} + \frac{(1-\kappa)}{\kappa e_s+(1-\kappa)}[z^H_{L,s}+nz^F_{L,s}]} \tag{8}$$

which, as a function of real money demands, yields a quadratic in e_s with one positive root. Notice, the nominal definition of the basket currency gives import to the nominal ratio of the currency supplies χ, as it influences how basket currency demand affects exchange rates. Further, this equation makes clear that there could not exist a stationary equilibrium in the form we seek without equal money growth across the two sovereign currencies; the underlying nominal definition of the basket currency creates nominal demand for the sovereign currencies, requiring equal nominal growth.

Because we have fixed the money supply across states, the relative price ζ_j depends only on relative demand across the two states. Given the exchange rate, we can write

$$\zeta_H = \frac{z^H_{H,T} + nz^F_{H,T} + \frac{\kappa e_T}{\kappa e_T + (1-\kappa)}(z^H_{L,T} + nz^F_{L,T})}{z^H_{H,N} + nz^F_{H,N} + \frac{\kappa e_N}{\kappa e_N + (1-\kappa)}(z^H_{L,N} + nz^F_{L,N})}, \tag{9}$$

and

$$\zeta_F = \frac{z^H_{F,T} + nz^F_{F,T} + \frac{1-\kappa}{\kappa e_T + (1-\kappa)}(z^H_{L,T} + nz^F_{L,T})}{z^H_{F,N} + nz^F_{F,N} + \frac{1-\kappa}{\kappa e_N + (1-\kappa)}(z^H_{L,N} + nz^F_{L,N})}. \tag{10}$$

For completeness,

$$\zeta_L = \frac{\kappa\phi^H_T + (1-\kappa)\phi^F_T}{\kappa\phi^H_N + (1-\kappa)\phi^F_N} = \zeta_F \frac{\kappa e_T + (1-\kappa)}{\kappa e_N + (1-\kappa)}$$

where the second equality comes from substituting definitions for e_s and ζ_F.

6 Numerical Exercise

This section explores the properties of the equilibrium described above. We parameterize the model at an annual frequency. Table 1 summarizes the standard parameter values. We calibrate the home country to match US targets, and the foreign country to match moments for Mexico. In terms of functional forms, we follow Lagos and Wright (2005) and set $u(q) = \log(q+b) - \log(b)$ for a small positive constant $b = .0001$. We normalize sellers' costs of production in the decentralized market to be $c(q) = q$. In the centralized market, we assume $U(x) = x$. This, with linear disutility of labor, implies that CM trade produces no surplus. This is a normalization with the only implication that all of our welfare statements below should be read as statements regarding DM welfare, and so regarding the portion of social surplus derived from transactions requiring cash. And, again as a result of linear disutility of labor, the welfare effects that our model predicts have direct cardinal implications, and so need not be converted into consumption units.

We set the discount factor, β, to .966, corresponding to an annual interest rate of 3.5%. Annual inflation is 2%, a standard target for central banks in advanced economies.[6] Buyers' bargaining power is set to 0.5, a standard value. The degree of trade openness, measured as $1 - \overline{\alpha}$, is set to .3232. We calibrate this parameter as the ratio of US imports and exports relative to GDP in the fourth quarter of 2017, a measure of trade relative to total output. The relative size of the foreign country is set to match the relative size of the population of Mexico to the US in 2017. Persistence of the trade and no trade states are calibrated such that the simulated shock process generates the number of "trade agreements" (transition

[6]In 2016, US consumer price inflation was 1.26% and Mexican consumer price inflation was 2.82%; average inflation rates since 2000 are 2.19% and 4.64%, respectively.

Table 1: Parameter Values

	Parameter	Target	Value
β	Discount Factor	Annual RIR 3.5%	.966
γ	Inflation	Annual Inflation Rate	2%
η	Bargaining Power	Standard Value	.5
$\overline{\alpha}$	Trade openness	(Imports+Exports)/GDP, 2017	.6768
n	Relative size of Foreign	pop. Mexico/ pop. US, 2017	.3967
ρ_T	Persistence of T	trade agreements in post-war	.86
ρ_N	Persistence of NT	trade wars in post-war	.72
μ	Relative size, Home money supply	M1 Mexico/M1 US, 2017 \$	.7842

from the no trade to trade state) and the number of "trade wars" (transition from the trade to no trade state) that have occurred in the US in the post-war period.[7] The size of the home money supply relative to foreign is set to match the ratio of M1 in the US to M1 in Mexico, converted to US dollars, in December 2017. Finally, we set the weights of each currency in the basket, $\kappa = 0.5$, but explore the welfare implications of changes in the basket weights in Section 6.3.

The remaining parameters relate to sellers' currency acceptance probabilities, or types. We compare the relevant cases, defined by different assumptions regarding sellers' acceptance decisions, in the results below. Case 1, the national currency equilibrium, is the one in which sellers accept only their domestic currencies. Case 2 is the international currency equilibrium, resembling a dollar-dominant regime, in which foreign private sector sellers accept the home and foreign currencies, while home sellers accept only their domestic currency. Case 3 supposes the basket becomes widely used in the foreign country, and almost all foreign sellers accept both the basket currency and their domestic currency, while home sellers only accept their domestic currency. In case 4, almost all home sellers accept the basket and their domestic currency, while foreign sellers only accept their domestic currency. Finally, case

[7] The trade agreements are: Israel-United States Free Trade Agreement (1985), NAFTA (1994), Jordan-United States Free Trade Agreement (2001), Australia-United States Free Trade Agreement (2004), Chile-United States Free Trade Agreement (2004), Singapore-United States Free Trade Agreement (2004), Bahrain-United States Free Trade Agreement (2006), Morocco-United States Free Trade Agreement (2006), Oman-United States Free Trade Agreement (2006), Peru-United States Trade Promotion Agreement (2007), Dominican Republic-Central America Free Trade Agreement (2005), Panama-United States Trade Promotion Agreement (2012), United States-Colombia Free Trade Agreement (2012), United States-South Korea Free Trade Agreement (2012). The trade wars are: US-Europe tariffs of 1963, Japanese Voluntary Export Restraint program of 1981, US-Canada lumber disagreement (1982-present), US-European food tariffs (1985), US-European banana tariffs (1993), Steel tariffs (2002-2004), Chinese tariffs (2018-present).

5 is the basket-dominant equilibrium in which both countries' private sector sellers accept both the basket and their own currency. In cases 2 and 5, we calibrate the acceptance probabilities to match the equilibrium share of government expenditure to GDP in US (Home) and Mexico (Foreign).[8] In cases 3 and 4, we set the share of sellers who accept the basket to 0.97 to illustrate the mechanism; lower acceptance probabilities result in zero demand for the basket.[9] The acceptance probabilities in each case are summarized in Table 2.

Table 2: Acceptance Probabilities

	Case	$\theta^F_{\{F\}}$	$\theta^H_{\{H\}}$	$\theta^F_{\{FH\}}$	$\theta^H_{\{HF\}}$	$\theta^F_{\{FL\}}$	$\theta^H_{\{HL\}}$
1:	National Currencies	1	1	0	0	0	0
2:	International Currency	.3367	1	.6633	0	0	0
3:	F accept Basket	.03	1	0	0	.97	0
4:	H accept Basket	1	.03	0	0	0	.97
5:	F and H accept Basket	.3367	.3333	0	0	.6633	.6667

6.1 Equilibrium Effects of Trade Shocks

We now explore the equilibrium allocations in the model, considering each of the cases corresponding to different currency acceptance decisions on the part of sellers. For intuition, we comparing our results to a baseline case without trade shocks, that is, $\rho_T = \rho_N = 1$. This section demonstrates that the presence of trade shocks can lead buyers to demand the basket currency, even though it is only accepted as an almost perfect substitute for a seller's own currency. As discussed in the previous section, trade shocks both affect spendability through changes in meeting rates between buyers and sellers, and insurance through their effects on portfolio reallocation and aggregate demand fluctuations.

To better understand these forces, we begin by looking at the relative currency demand in each case, shown in Table 3. The key mechanism of the model relies on the fact that trade shocks lead to shifts in relative demand for each currency which in turn affect agents' consumption through changes in the real value of goods that they are able to trade. When the economy transitions from the no trade to trade state, the real value of each currency increases due to higher demand for domestic currency from agents abroad, with the percentage change

[8] We assume that the government runs a balanced budget and compute government revenue as the value of goods sold by sellers who only accept domestic currency, relative to total sales in each country in the DM.

[9] If all foreign private sector sellers accept L and F, the they become perfect substitutes, causing numerical instabilities and the potential for multiple equilibria. Hence, we assume a small fraction of foreign sellers still only accept their domestic currency. A similar assumption is made in case 4.

in the purchasing power of the currency given by $\zeta - 1$. Conversely, when the state transitions from trade to no trade, the percentage change in the purchasing power is $\zeta^{-1} - 1$.

The associated currency demand is shown in Table 4 and is expressed in units of home currency (dollars). To do so, we divide currency holdings by the equilibrium value in the CM of home currency ϕ_s^H, for $s = T, N$, in each case.[10] The units of the entries in Table 4 are the annual home country M1 held by the public. Though these balances may seem large, they should be interpreted as the sum of individual cash holdings and bank reserves.

Table 3: Relative Currency Demand, ζ

		Home	Foreign	Basket
	Baseline, No Shocks	1.347	3.302	1.811
1:	National Currencies	1.049	1.095	1.068
2:	International Currency	1.046	0.969	1.032
3:	F Accept Basket	1.058	1.090	1.071
4:	H Accept Basket	1.071	1.083	1.076
5:	F and H Accept Basket	1.048	1.092	1.066

Table 4: Buyers' Money Holdings (Thousands of Dollars)

	Case	z_H^H	z_F^H	z_L^H	z_H^F	z_F^F	z_L^F
	Baseline, No Shocks; No Trade	8.63	0	0	0	8.63	0
	Baseline, No Shocks; Trade	8.23	8.29	0	8.58	7.62	0
1:	National Currencies; No Trade	8.62	6.37	0	6.42	8.71	0
1:	National Currencies; Trade	8.58	7.38	0	7.91	8.50	0
2:	International Currency; No Trade	8.61	.00004	0	6.34	7.86	0
2:	International Currency; Trade	8.63	.0007	0	7.57	7.62	0
3:	F Accept Basket; No Trade	8.64	6.27	0	6.57	8.70	0
3:	F Accept Basket; Trade	8.58	7.18	.224	7.89	8.29	.215
4:	H Accept Basket; No Trade	8.58	6.10	.085	4.47	8.69	2.28
4:	H Accept Basket; Trade	8.59	7.42	0	7.87	8.50	0
5:	F and H Accept Basket; No Trade	8.44	6.14	.284	6.15	8.49	.339
5:	F and H Accept Basket; Trade	8.24	7.04	.513	7.54	8.13	.558

[10] To compute ϕ_s^H, equation (7) implies that we take a stand on the value of M_H. Thus, we set M_H as M1/population in the United States in 2017: \$11,128.

6.1.1 The International Currency Model

We begin by discussing the international currency equilibrium (case 2). A share of foreign sellers, the government sector, only accept foreign currency, while the remaining share, private sellers, accept both foreign and home currency. Table 3 shows that, because of asymmetric effects of trade shocks on currency demand in the two countries, demand for the home currency is higher in the trade state, while demand for the foreign currency is higher in the no trade state. Turning to Table 4, this results from fluctuations in foreign buyers' demand. Home buyers hold nearly the same portfolio across states, since they are highly likely to meet a seller who accepts home currency in both states. Differently, foreign buyers face a non-trivial decision. In the trade state, they are more likely to meet home country sellers, all of whom accept the home currency, so they hold significantly more home currency in the trade state. While many foreign sellers accept the home currency, a number do not, so the share of meetings where only foreign currency is accepted increases for foreign buyers in the no-trade state, leading them to demand more foreign currency.

6.1.2 One Country's Sellers Accept the Basket

Turning to the first case in which the basket is accepted by some sellers, case 3, foreign buyers may be able to spend the basket in both states of the world, while home buyers may only spend the basket when the economy is in the trade state. Differently, buyers in both countries agree on the insurance motive: when some foreign sellers accept the basket, it is useful to insure against falls in the value of the foreign currency when transitioning into the no-trade state. This can be seen in Table 3: the value of ζ for the basket currency is less than that for foreign, meaning that the basket appreciates less than foreign currency when transitioning from the no trade into the trade state, but also depreciates less than the foreign currency in the opposite transition. It follows that the basket is preferred to the foreign currency by both buyers in the trade state, but for different reasons. When transitioning into the no trade state, the relative depreciation of the foreign currency implies that, by holding the basket, foreign buyers can purchase more consumption goods in the DM, increasing their utility and smoothing consumption relative to the trade state. Alternately, for home buyers, when the economy transitions into the no trade state, they no longer have the spendability motive to hold the basket as they never meet foreign sellers. However, home buyers still prefer to hold the basket in order to trade it on the centralized foreign exchange market, again receiving higher consumption than they would if holding foreign currency. Indeed, Table 4 shows that both buyers hold the basket only in the trade state, suggesting that the insurance motive dominates. Overall, the basket makes up just 1.4% of the home buyer's portfolio and 1.3%

of the foreign buyer's portfolio, in units of home currency.

The opposite pattern is observed in case 4, in which only a share of home sellers accept the basket. Here, the spendability motive is always present for home buyers, but only present in the trade state for foreign buyers. Instead, the insurance motive is present for both buyers in the no trade state: when transitioning from the no-trade to trade state, the home currency appreciates by less than the foreign currency, as seen in Table 3. This is because, due to the larger size of the home country, the increase in demand for foreign currency from home buyers is larger than the increase in demand for home currency from foreign buyers. Again in this case, the insurance motive dominates as all buyers only hold the basket in the no-trade state, shown by their portfolio allocations in Table 4. Differently, foreign buyers hold the basket in the state in which they cannot spend it, as they meet no home sellers in the no trade state. It is only in the periods following a transition to the trade state that foreign buyers benefit from holding the basket instead of the home currency. In this case, the basket makes up less than 1% of the home buyer's portfolio, but almost 15% of the foreign buyer's portfolio, while worldwide basket demand is 4.7% of total currency demand. Basket demand by foreign buyers is far larger in case 4 than is demand by home buyers in case 3 due to the fact that the home country is relatively larger, and therefore the expected spendability of the basket is higher.

6.1.3 Both Countries' Sellers Accept the Basket

Finally, in the case that a share of sellers in both countries accept the basket, the spendability motive is always present, as buyers can spend the basket in both the trade and no trade states, though at different rates. Similarly, the insurance motive for both buyers is present in both states: in the no trade state, buyers value the basket as insurance against a fall in the value of the home currency, while in the trade state, the insurance is against a fall in the value of the foreign currency. Table 3 shows the values for relative currency demand in this case. Because buyers hold the basket in both states, fluctuations in currency demand for both the home and foreign currencies are relatively small. However, the foreign currency's value remains volatile. When both countries' sellers may accept the basket, basket demand is between 1.9% is 3.4% of buyers' portfolios, depending on the buyers' location and the state of trade. In this case, world demand for the basket is 2% of total currency demand in the no trade state, and 3.3% of total currency demand in the trade state.

Notice that moving from case 2 to case 5, buyers' currency holdings increase by over 40%. Thus, buyers can purchase more in the decentralized market, raising the welfare of both parties. Though welfare is not shown here, the model predicts that transitioning from the international currency equilibrium to the equilibrium in which both countries' sellers accept the basket currency can improve world welfare in the decentralized market by 22%. To put this number in context, Lagos and Wright (2005) put decentralized trade at approximately 10% of GDP. Hence, because of quasi-linearity, our model suggests that overall world welfare would improve by approximately 2% if the basket currency were widely accepted by private sector sellers.

6.2 Partial Equilibrium Effects of Trade Shocks

To understand why demand for the basket is low even when a majority of both countries' sellers accept, we must take a step back and study buyers' decisions in partial equilibrium. In the previous section, relative currency demand and portfolio choices are jointly determined: buyers choose their portfolios taking as given the insurance benefits of the basket relative to the two countries' currencies, but their decisions themselves determine the relative currency demand and therefore the purchasing power of each currency. Intuitively, the basket is a combination of the two countries' currencies, thus, as demand for the basket increases, demand for each currency that makes up the basket also increases. If demand differs across states, this money demand effect will change the purchasing power of each currency across states, affecting buyers' portfolio allocations. In this section we disentangle the effect of demand for the basket given each currency's purchasing power from the effect of basket demand itself on the purchasing power of its component currencies.

To do so, we fix the exchange rate and relative currency demand for home and foreign currency at their equilibrium levels in the national currency case (case 1), that is we fix $\zeta_H = 1.049$, $\zeta_F = 1.095$, $e_N = 1.45$, and $e_T = 1.39$. We then solve for the equilibria in cases 3 through 5, allowing ζ_L to adjust, and compare currency demand in each case. The results are shown in Table 5.

A key takeaway from Table 5 is that buyers' holdings of the basket currency in cases 3 and 4 are far higher than in the general equilibrium (shown in Table 4). When holding the basket increases expected consumption without affecting purchasing power of the component currencies across states – because we fix those values – buyers' demand increases in the state where the insurance motive is present. In the case in which foreign sellers accept the basket, home buyers' portfolio share in the basket increases from 1.4% to 12% and foreign buyers' share increases from 1.3% to 3.3%. Global basket demand increases from 1.4% to 9.5%. In the opposite case, in which home sellers accept the basket, home buyers' portfolio share increases from 0.6% to 4.9% and foreign buyers' share increases from 15% to 43%. In this case, global basket demand increases from 4.7% to 16%. This is the basis for our claim that the general equilibrium effects of the basket currency limit adoption of the basket currency

Table 5: Buyers' Money Holdings, Partial Equilibrium (Thousands of Dollars)

	Case	z_H	z_F	z_L	$\hat{z}_H$	$\hat{z}_F$	$\hat{z}_L$
	Baseline, No Shocks; No Trade	8.63	0	0	0	8.63	0
	Baseline, No Shocks; Trade	8.23	8.29	0	8.58	7.62	0
1:	National Currencies; No Trade	8.62	6.37	0	6.42	8.71	0
1:	National Currencies; Trade	8.58	7.38	0	7.91	8.50	0
2:	International Currency; No Trade	8.62	0	0	6.42	8.31	0
2:	International Currency; Trade	8.63	0	0	7.54	7.29	0
3:	F Accept Basket; No Trade	8.62	6.37	0	6.42	8.71	0
3:	F Accept Basket; Trade	8.58	5.50	1.92	7.91	7.97	.545
4:	H Accept Basket; No Trade	7.91	6.37	.736	0	8.71	6.63
4:	H Accept Basket; Trade	8.58	7.38	0	7.91	8.50	0
5:	F and H Accept Basket; No Trade	8.44	6.18	.283	6.18	8.49	.334
5:	F and H Accept Basket; Trade	8.24	7.03	.514	7.53	8.13	.561

Notes: Partial equilibrium holds ζ_H and ζ_F constant at their general equilibrium values in Case 1 (National Currency). The implied ζ_L is also held constant. Dollar values are computed using the CM price of home currency in the trade state in the International Currency equilibrium as described in footnote 10.

– in partial equilibrium, basket demand is much higher. In the final case, in which both countries' sellers may accept the basket, there is little change in buyers' currency demand in partial relative to general equilibrium. Because the insurance motive is present in both states, there is a natural tension between insurance for the two currencies, leaving portfolio allocations largely unaffected.

To sum up, although proposals for basket currencies claim that they can become important and improve the welfare of users above what any national currency can achieve, this section shows that the insurance benefits of the basket currency are only significant when the basket itself is not so widely held that it affects underlying currencies. When only one country's sellers accept the basket, as its share of the global currency portfolio rises, so does volatility in the component currencies, decreasing the value of holding the basket. This general equilibrium effect offsets the benefits of the basket for trade or exchange rate speculation, leading to low global demand.

Finally, it should not be assumed that ignoring the general equilibrium effects of a basket currency is sufficient for making robust conclusions about the demand for the basket as long as enough sellers in both countries accept it. As we will show in the next section, although the portfolio allocations in the benchmark calibration do not significantly change from partial to general equilibrium when both countries' sellers accept the basket, the welfare effects of the basket composition vary substantially. Thus, it is imperative to take into account how even minor volatility in basket demand affects the prices and purchasing power of its component currencies.

6.2.1 Exchange Rates

Standard models of international trade highlight the role of the exchange rate on trade and welfare. However, in models with search frictions such as ours, exchange rates can be minimally volatile while the rate of return on the payments medium varies substantially. This arises in our model for several reasons. First, the presence of trade shocks leads to fluctuations in the value of each currency across states. These fluctuations – and not exchange rate fluctuations – affect welfare, portfolio allocations, and relative currency demand. Second, we focus only on adjustments on the intensive margin, that is, changes in buyers' currency holdings, rather than on the extensive margin, as the lack of a choice to match in the DM effectively fixes the rates at which buyers and sellers from different countries meet in each state. Third, in order to understand buyers' demand for the basket currency we fix sellers' acceptance strategies and do not allow trading partners to change the currency in which they trade after meeting.

As can be seen from Table 6, the model results in equilibrium exchange rates between the two states that are nearly identical in cases 3 and 4. However, as shown in the previous section, basket demand is exactly opposite across the two equilibria.

Table 6: Exchange Rate (Home/Foreign)

	Case	No Trade	Trade
	Baseline, No Shocks	3.21	1.31
1:	National Currencies	1.45	1.39
2:	International Currency	4.55	4.91
3:	F Accept Basket	1.45	1.39
4:	H Accept Basket	1.45	1.38
5:	F and H Accept Basket	1.47	1.41

6.3 Welfare-Maximizing Basket Weights

With or without the basket currency, buyers carry some quantity of each sovereign currency. One can think of buyers' holdings of each currency as forming an endogenous basket – a portfolio comprising a share, $\tilde{\kappa}$, of the home currency and a complementary share, $1 - \tilde{\kappa}$, of the foreign currency. In general, $\tilde{\kappa}$ will be different for domestic and foreign buyers due to differences in meeting rates. Thus, the welfare-maximizing weights of each currency in the basket will be different depending on which country's welfare is being maximized.

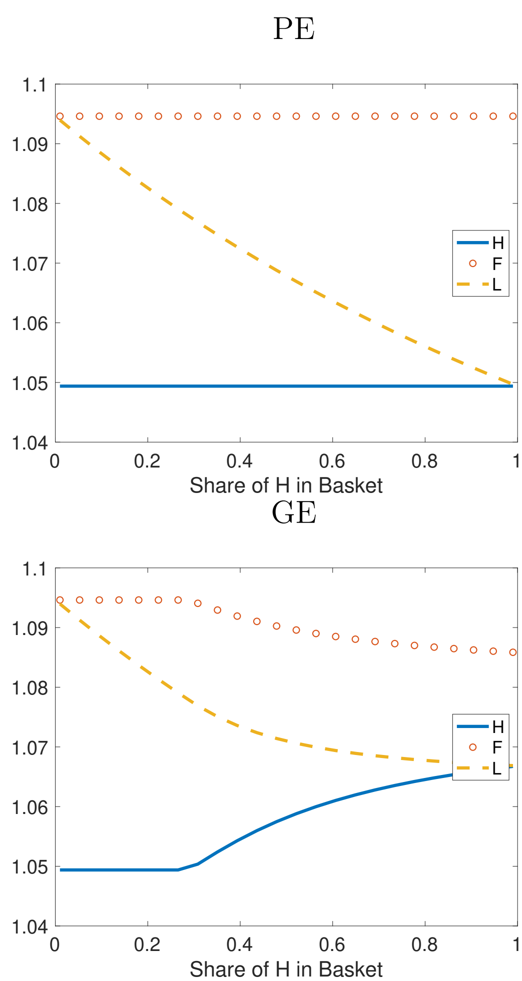
In this section we compare world welfare across basket weights κ. Recall that $\kappa = 0$ ($\kappa = 1$) implies that the basket is made up of 100% foreign (home) currency. By changing the composition of the basket currency while keeping acceptance probabilities constant, we affect its insurance value without affecting its spendability. To build intuition for the comparative statics, we compare the partial equilibrium to the general equilibrium results. We begin with the case that foreign sellers accept the basket currency before turning to the case in which both countries' sellers accept. The case in which home sellers accept the basket is the mirror image of the foreign sellers accept case, and is omitted for brevity.

6.3.1 Foreign Sellers Accept the Basket

Figure 1 shows the relative currency demand for each currency in partial equilibrium (top panel) and general equilibrium (bottom panel). The effect of fixing the values of ζ_F and ζ_H, as well as the exchange rate implies that as κ increases, the value of the basket currency becomes more similar to that of the home currency, that is, ζ_L approaches ζ_H at a roughly constant rate. Differently, in general equilibrium, as the basket becomes more like the home currency, its volatility also increases due to buyers' portfolio decisions across states. As can be seen in Figure 2 and as was discussed in reference to Table 4, buyers hold the basket only in the trade state in order to insure against falls in the value of foreign currency. When the values of ζ_H and ζ_F are fixed in partial equilibrium, fluctuations in demand for the basket do not lead to fluctuations in the value of its component parts. Instead, when the values of ζ_H and ζ_F adjust, the higher is κ, the higher is the share of home currency demanded in one state, and the more volatile the value of the home currency becomes. This decreases the insurance benefit of holding the basket, leading the basket to comprise a far lower portfolio share for buyers in both countries.

Importantly, the partial equilibrium results in Figure 2 show that home buyers replace all of their foreign currency holdings with the basket currency when κ is high enough. This is because the share of sellers who do not accept the basket is relatively small, even more so since the foreign country itself is smaller than the home country. Thus, the endogenous meeting rate between home buyers and foreign sellers who do not accept the basket is low enough, and the insurance value of the basket currency against changes in the trade state is high enough, that home buyers choose to hold no foreign currency in the trade state. Instead, foreign buyers are likely to meet foreign sellers who do not accept the basket, and thus continue to hold some foreign currency in both states. However, there is some

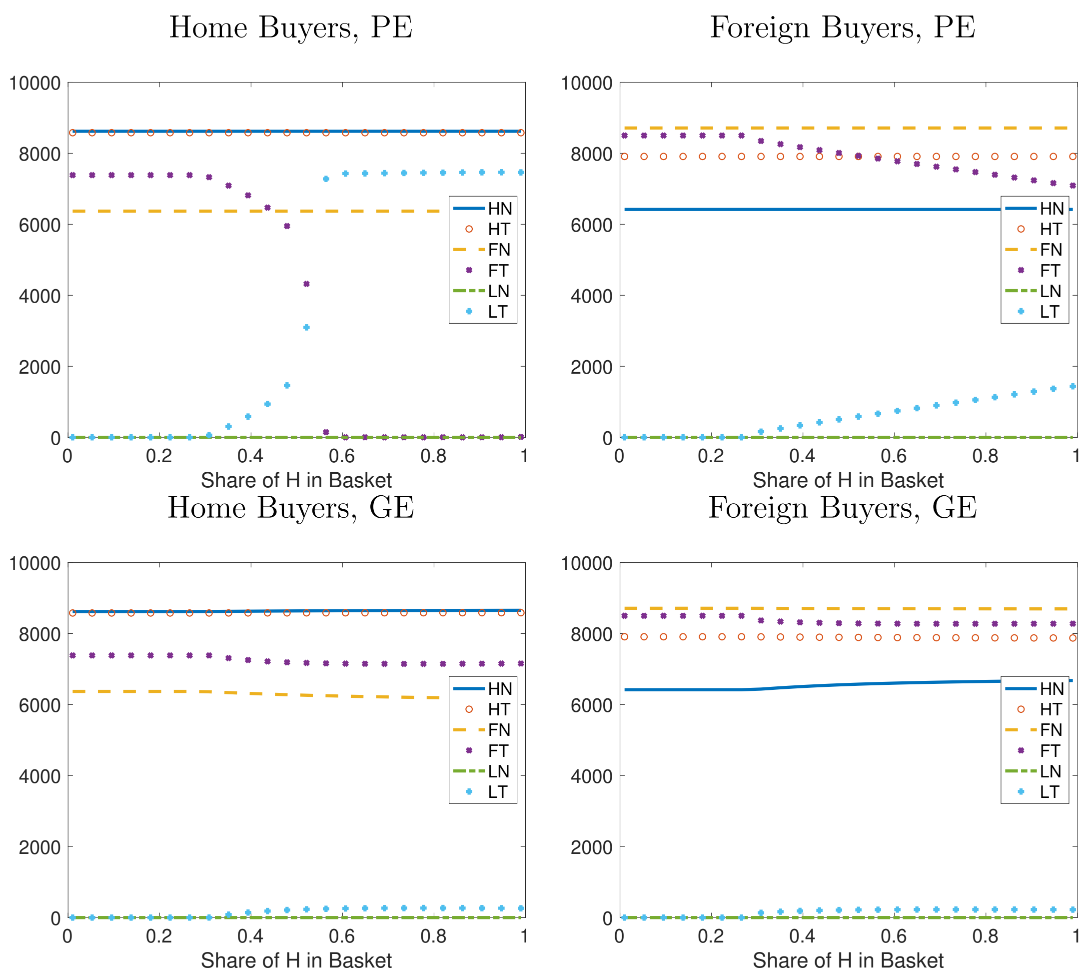
Figure 1: Relative Currency Demand, Foreign Sellers Accept Basket



reallocation into the basket currency as it becomes better insurance for the foreign currency in the trade state.

In general equilibrium, the portfolio composition is very different. As shown in Figure 1, improvements in the insurance value of the basket as κ increases are offset by higher volatility in the home currency, decreasing the benefits of the basket relative to the foreign currency (graphically, ζ_L falls by less relative to ζ_F in general equilibrium). Thus, the overall effect of a change in the composition of the basket has negligible effects on portfolio composition once we take into account the effects of basket demand on the relative values of each country's currency.

Figure 2: Real Money Holdings, Foreign Sellers Accept Basket



The resulting changes in DM welfare are shown in Figure 3. To illustrate the effect of changes in the basket composition, we normalize welfare in each equilibrium by its level when $\kappa = .5$. In the next section, we consider overall welfare implications in the equilibria with and without the basket currency. In both the partial and general equilibrium figures, changes in welfare from the presence of the basket currency are small, between 0 and 1% of individual welfare, and less than .15% of world welfare. Starting with the country-level, partial equilibrium results shown in the top right panel, home sellers' welfare is unaffected as buyers' portfolio allocations in the home currency, and therefore their purchases in meetings with home sellers, are constant. Differently, the average foreign seller is worse off the larger is κ, since home buyers fully substitute out of foreign currency in the trade state, reducing their purchases with those sellers who do not accept the basket, as seen in the dot-dashed line in the top right panel of Figure 3. After this drop off, however, private foreign sellers who do accept the basket benefit from higher κ because of the improved insurance. For both countries' buyers, this improvement in the insurance value leads to higher welfare, the more so for home buyers whose portfolio reallocation towards the basket currency is larger in the trade state.

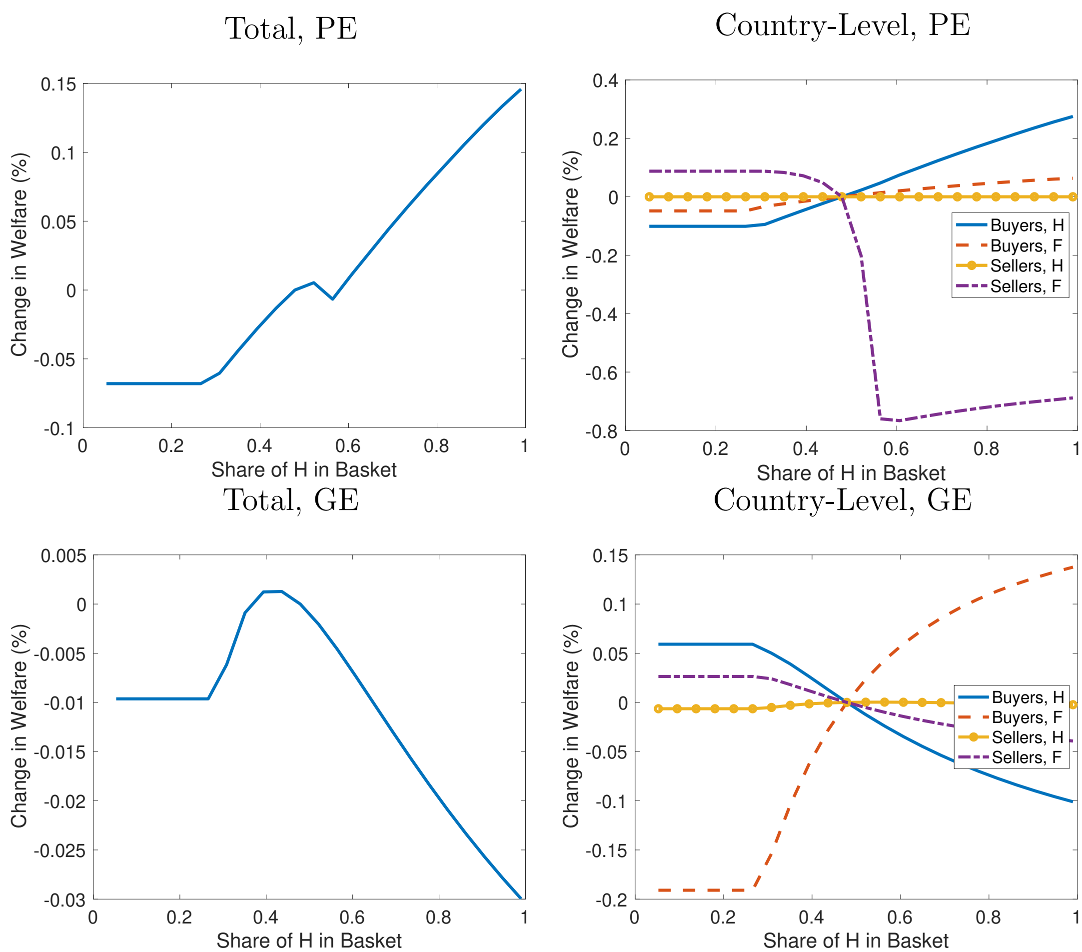
In general equilibrium, the bottom right panel of Figure 3, there is a threshold value of κ below which all buyers hold none of the basket. This corresponds to the flat welfare effects below $\kappa = .25$. As κ increases further, again there is little effect on home sellers' welfare as purchases in home currency do not change much as the basket composition changes. For foreign buyers, their welfare losses are minimal relative to the partial equilibrium because home buyers no longer fully reallocate to the basket in the trade state. For home buyers, the higher is the share of home currency in the basket, the higher is the volatility in home currency, hurting their welfare as they are more likely to meet home sellers in both states. For foreign buyers, the effect is the opposite: an increase in κ implies both an insurance value against depreciation in the foreign currency, as well as an reduction in the volatility of the foreign currency itself.

Looking at the left panels of Figure 3, taking into account the general equilibrium effects largely reverses the results for the optimal composition of the basket. In partial equilibrium, the basket provides the most insurance the less it resembles the foreign currency, thus $\kappa = 1$ is optimal. In general equilibrium, the relative size of the home country implies that home welfare has a higher weight in world welfare, reducing the benefits of a high value of κ and resulting in an optimal basket weight of $\kappa = .4$.

6.3.2 Both Countries' Sellers Accept the Basket

Turning to the case in which a share of both countries' sellers accept the basket, we fix the values for ζ_H, ζ_F, and the exchange rate to be the same values as in the national currency regime, case 1, in partial equilibrium. Figure 4 shows the resulting relative currency demand. In general equilibrium, for low levels of κ, the basket is very similar to the foreign currency, and thus provides little insurance in the trade state against the foreign currency, but much

Figure 3: Welfare, Foreign Sellers Accept Basket



insurance in the no trade state against the home currency. However, because the basket is demanded in both states, as the share of home currency in the basket increases, the amount of home currency held overall increases, leading to a decrease in the volatility of the home currency's value across states. As the share of home currency in the basket continues to increase (roughly for $\kappa > 0.4$), Figure 5 shows that the amount of the basket demanded in the two states begins to significantly diverge, leading to more volatility in the home currency. The opposite mechanism is responsible for movements in the relative foreign currency demand.

In terms of welfare, Figure 6 illustrates the stark difference in the conclusions for the optimal basket allocation when considering partial and general equilibrium. The top right panel shows the decomposition of welfare by buyers and sellers in each country in partial equilibrium. Foreign buyers experience the greatest welfare gains as κ increases, because they benefit from the insurance value against the foreign currency more than they lose from the lack of insurance against the home currency, since they meet foreign sellers more frequently.

Figure 4: Relative Currency Demand, Both Sellers Accept Basket

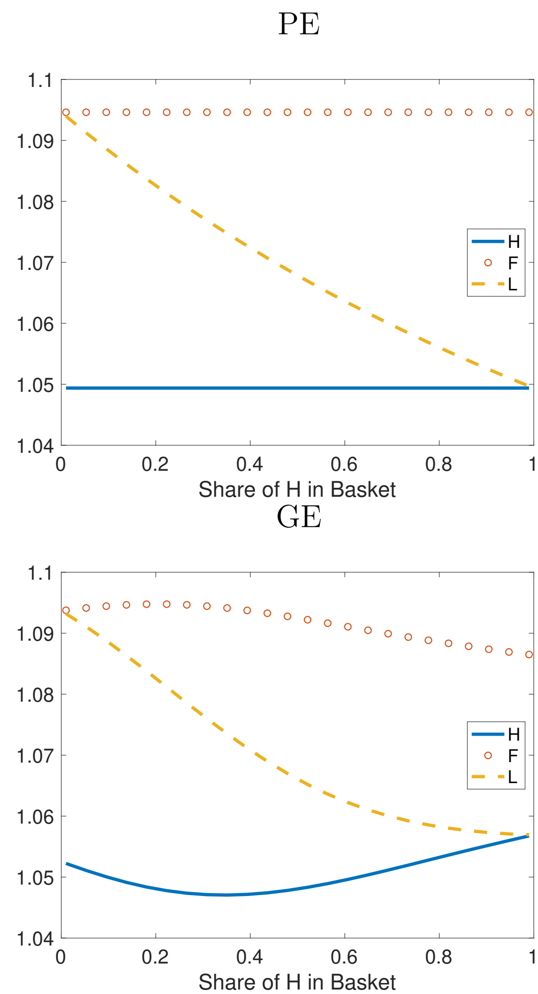
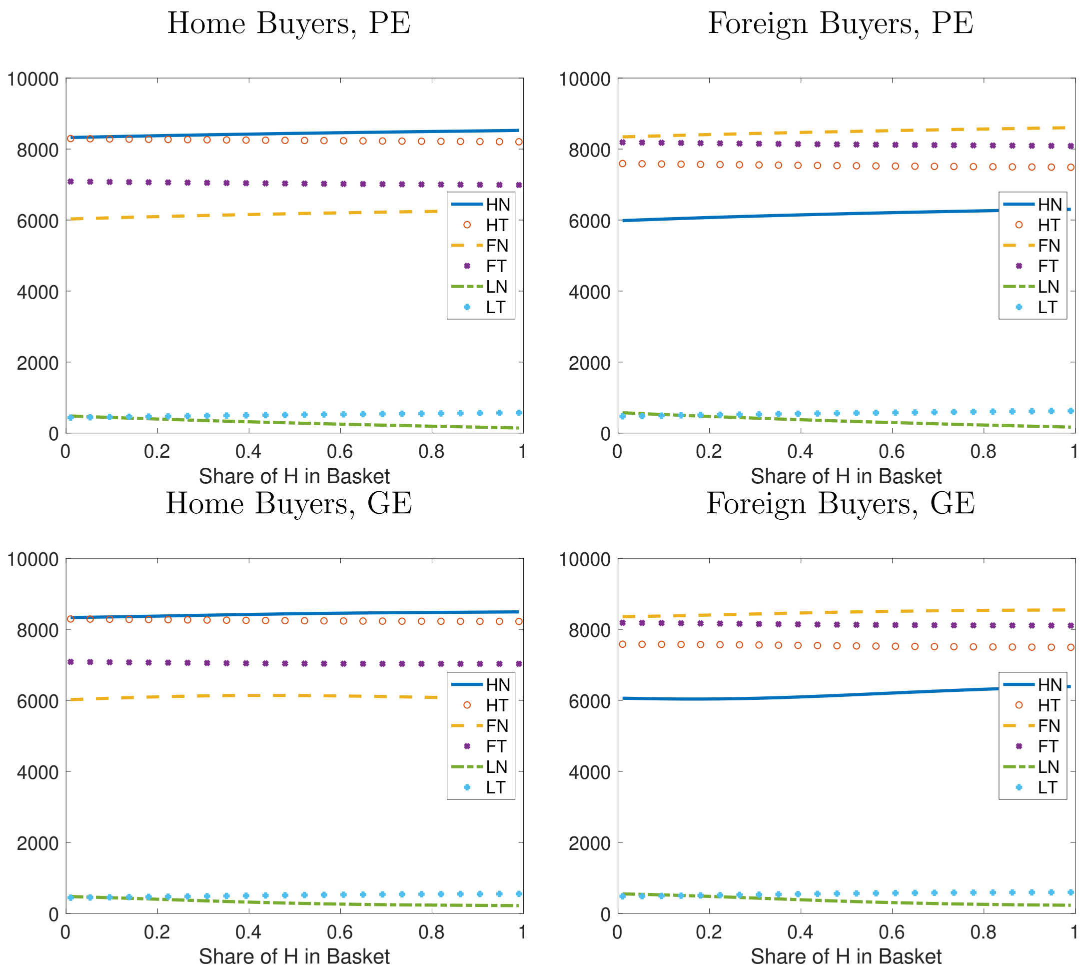


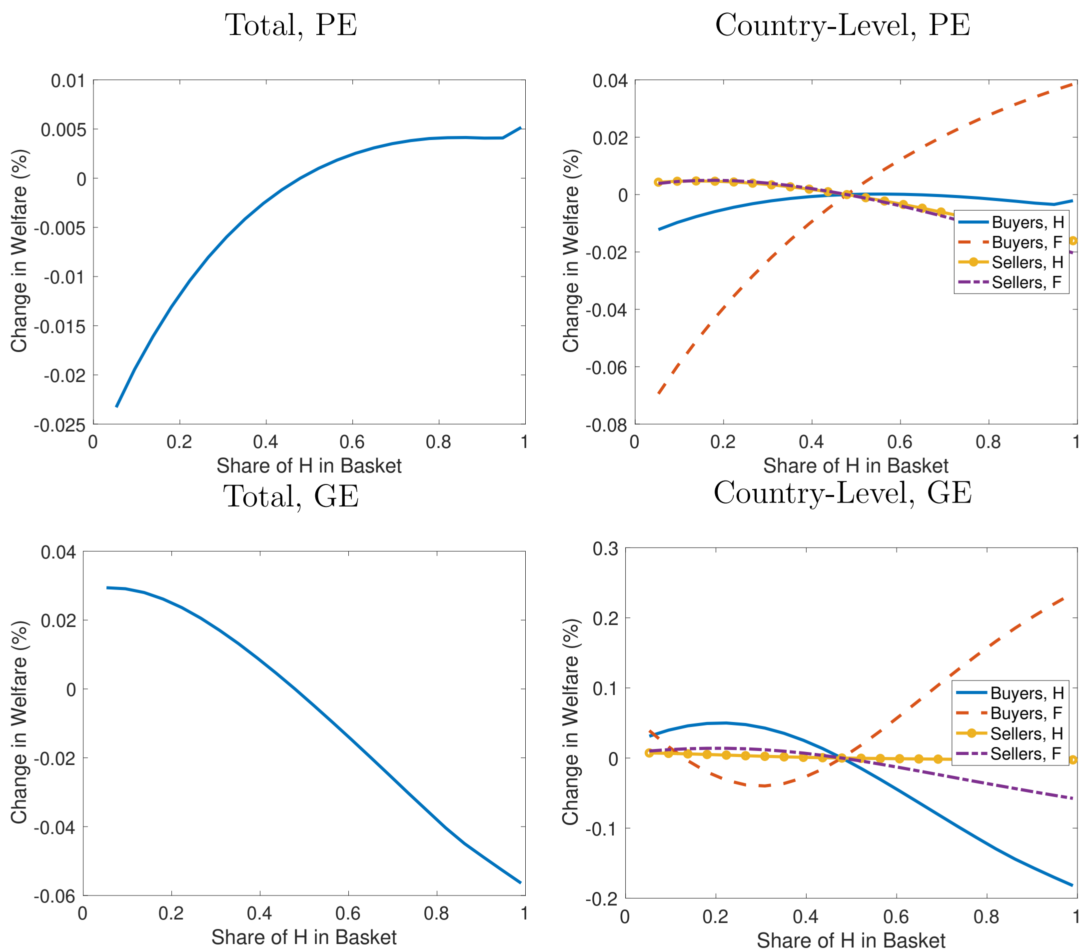
Figure 5: Real Money Holdings, Both Sellers Accept Basket



Differently, home sellers are nearly unaffected by changes in the basket composition, as the insurance benefits against the foreign currency are offset by the insurance losses against the home currency. Finally, both sellers' welfare is mildly downward sloping. This is because, as can be seen in the first row of Figure 5, buyers decrease their holdings of the basket currency in the no trade state, decreasing the amount that they can purchase in DM meetings, and thus the consumption of sellers who accept the basket. The resulting optimal basket composition for world welfare in partial equilibrium is $\kappa = 1$ as the increase in foreign buyers' welfare as κ increases dominates the relatively flat welfare of the other buyers and sellers. Thus, the optimal basket is made up of 100% home currency. That is, dollar dominance is optimal in partial equilibrium.

Turning to the general equilibrium results, the welfare effects are larger and the implications for the composition of the optimal basket are starkly different than in partial equilibrium. As above, sellers' welfare is roughly flat, though foreign sellers' welfare falls

Figure 6: Welfare, Both Sellers Accept Basket



by more than that of home sellers because home buyers substitute their foreign currency holdings for the basket as its insurance value against foreign devaluations increases. The welfare effects are more interesting for both countries' buyers. Home buyers' welfare initially increases as ζ_H falls due to the fact that initial increases in κ lead to more stability in the home currency's value across states (Figure 4). As κ increases, the basket demand across states from each buyer starts to diverge, and the basket starts to add volatility to the home currency, decreasing the welfare of home buyers. The opposite forces are at play for foreign buyers. Overall, because there are more home buyers than foreign buyers, their welfare dominates and the optimal basket sets $\kappa = 0$, that is, the optimal basket is 100% foreign currency.

6.4 Potential for Basket Adoption

Although we take sellers' currency acceptance decisions as given, we can examine sellers' welfare in the cases above to test whether sellers would be likely to accept the basket were they given the choice. We hold all parameters constant at their values shown in Tables 1 and 2. To more easily interpret the incentives for sellers to accept the basket, we transform welfare, which is naturally measured in units of CM labor, into units of the home currency, that is, 2017 USD. As in Tables 4 and 5, we divide sellers' welfare in units of CM hours by the equilibrium value in the CM of home currency ϕ_s^H, for $s = T, N$, in each case. We then subtract the welfare of sellers who do not accept the basket from the welfare of sellers who do accept the basket, which gives us sellers' willingness to pay to accept the basket, conditional on being in the given equilibrium (cases 2 through 5). Table 7 displays the results.

Table 7: Sellers' Implied Willingness to Pay to Accept the Basket, $\kappa = .5$

Case	H, no trade	H, trade	F, no trade	F, trade
2: International Currency (accept home)	0	0	793.27	2201.38
3: F Accept Basket	-	-	0	57.52
4: H Accept Basket	46.69	0	-	-
5: F and H Accept Basket	19.63	53.30	34.01	136.24

Notes: Willingness to pay is denominated in 2017 USD, and is computed as the difference in sellers' welfare in CM hours, divided by the equilibrium value of home currency, ϕ_s^H. Entries for equilibria in which it is assumed sellers cannot accept the basket are omitted.

Table 8: Sellers' Implied Willingness to Pay to Accept the Basket, Optimal Weights

Case	H, no trade	H, trade	F, no trade	F, trade
2: International Currency (accept home)	0	0	793.27	2201.38
3: F Accept Basket	-	-	0	41.43
4: H Accept Basket	0	0	-	-
5: F and H Accept Basket	33.78	45.03	59.52	115.60

Notes: Willingness to pay is denominated in 2017 USD, and is computed as the difference in sellers' welfare in CM hours, divided by the equilibrium value of home currency, ϕ_s^H. Entries for equilibria in which it is assumed sellers cannot accept the basket are omitted. Optimal weights are $\kappa = .4$ in case 3, $\kappa = .9$ in case 4, and $\kappa = 0$ in case 5.

The first row of the table shows the results for the international currency equilibrium, where we report the value of accepting the home currency. In this equilibrium, home sellers always accept their own currency, thus their welfare gain from accepting the home currency is zero. Differently, foreign sellers who accept the home currency are significantly better off in both states than sellers who do not accept the home currency: foreign sellers would be willing to pay \$793 in the no trade state and \$2,201 in the trade state to be able to accept. The second row of the table shows the results in the equilibrium in which foreign sellers accept the basket. In this case, foreign sellers who do not accept would be willing to pay \$57 in the trade state, but nothing in the no trade state to accept the basket currency. This is because buyers hold the basket only in the trade state, thus sellers' welfare in the no trade state is unaffected by their decision to accept the basket. Symmetrically, when some home sellers accept the basket, those who do not accept would be willing to pay \$46 in the no trade state in order to accept, again because this is the state of the world in which buyers hold the basket currency. Finally, when some sellers in both countries accept the basket, home sellers would be willing to pay \$19 and \$53 to accept the basket in the no trade and trade states, respectively. Similarly, foreign sellers would be willing to pay \$34 and \$136 to accept the basket in the no trade and trade states. The reason both sellers are willing to pay more in the trade state is that buyers hold more basket currency in this state since the insurance motive against devaluations of the foreign currency is stronger. Comparing sellers' willingness to pay to the annual cost of maintaining a modern point-of-sale system suggests that the results in Table 7 may be too low to warrant adoption.[11]

When we allow for the optimal weights computed in Section 6.3, the results are largely unchanged. Table 8 shows that in cases 3 and 5, sellers' willingness to pay falls slightly in the trade state, while in the no trade state, willingness to pay increases slightly. In case 4, the optimal weight is $\kappa = 0.9$, which makes the basket close enough to the home currency that sellers are indifferent between accepting and not accepting the basket, resulting in a willingness to pay of zero. Thus, even when weights are optimal from the perspective of world welfare, sellers' willingness to pay to accept the basket remains modest.

7 Conclusion

In this paper we develop a new monetarist model of international trade to consider global demand for basket-backed stablecoins. In the model, money is valued as a medium of exchange in decentralized meetings, and trade shocks – variation in the number of international meetings – affect currency demand. Fluctuations in money demand lead to fluctuations in the price level and exchange rates of sovereign currencies which reduce the welfare of risk-averse consumers. We introduce a basket currency – a convex combination of the underlying sovereign currencies – with the potential to attenuate such fluctuations, and so improve wel-

[11] As of February 2020, the average cost of, for example, a Square Retail POS terminal is \$720, excluding the fixed and variable costs per transaction. See https://squareup.com/us/en/point-of-sale/retail.

fare. Our model highlights two motives that affect demand for the basket currency: the spendability motive and the insurance motive.

We calibrate the model to standard parameters and find that there is a small portfolio share allocated to the basket currency in all of the equilibria that we study. We show that this result is due to the fact that demand for the basket, which is made up of the two countries' currencies, increases demand for those sovereign currencies themselves. When basket demand varies across states, this leads to higher volatility of the values of the component currencies in general equilibrium, decreasing welfare. Thus, the benefit of insuring against fluctuations in the purchasing power of one or both countries' currencies is reduced when the basket itself affects such fluctuations. In the most generous case we study, in which roughly two-thirds of both countries' sellers accept the basket, the basket currency accounts for 2% of world currency demand when trade openness is low, and 3.3% of world currency demand when trade openness is high. Our model shows that although the basket may have the potential to become important and globally demanded, general equilibrium effects on the relative values of the component currencies when the level of trade changes make it such that the basket never dominates either of the component currencies. At the same time, the introduction of the basket leads the more volatile sovereign currency to become more stable, substantially increasing currency holdings, trade, and welfare; we find that welfare gains can be on the order of 2% of GDP when transitioning from a "dollarized" global economy to one in which the basket is globally accepted, although we emphasize that this is under generous assumptions regarding the acceptability of the basket and its other characteristics.

We show that the optimal basket composition varies significantly depending on which countries' sellers accept payment in the basket currency. This result follows from the insurance motive: when one currency is expected to depreciate when a trade shock is realized, buyers would prefer to pay that country's sellers using the basket. We show that these incentives are drastically reduced in general equilibrium, when currency demand affects expected rates of return on both the basket and component currencies, reducing the insurance motive. Because of these price effects, we find that changes in the basket composition have little effect on overall welfare, holding sellers' strategies constant.

Finally, we use the model to compute sellers' willingness to pay to accept the basket in each equilibrium we study. Because of the low demand for the basket by buyers, even when many other sellers accept, the difference in sellers' welfare by accepting or not accepting the basket is small, implying a low willingness to pay. Our estimates suggest that there must be significant benefits in addition to those we study here in order to achieve widespread adoption of basket-backed stablecoins.

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