Internet Appendix for "Commodity Trade and the Carry Trade: A Tale of Two Countries"

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This appendix contains supplementary material for the paper. Section I discusses the relationship between our results and the classic Balassa-Samuelson effect. Section II describes a general model that relaxes some the published version's simplifying assumptions. Section III provides details on data construction and discusses robustness of the empirical results.

I. Relative Productivity and Exchange Rates: Discussion

Relative productivity is an important object in international economics. In fact, our model's implied link between the productivity differential and the real exchange rate resembles the classic Balassa-Samuelson effect, whereby the relative price of nontraded (or relatively less traded) goods and, therefore the real exchange rate is higher for countries with higher labor productivity. This effect relies on the existence of a perfectly traded good and perfectly elastic substitution of labor between sectors. In the context of our model the basic commodity is the freely traded good and the commodity country always has an advantage producing it, but labor productivity differs across sectors. Nevertheless, the Balassa-Samuelson effect can still be seen at work in the sense that the price of the final consumption good is always higher in the commodity country than in the producer country, since it is more costly to produce it in or import it into the commodity country (and consequently marginal utility of consumption is higher). The effect of labor productivity is the reverse of that in the Balassa-Samuelson hypothesis because it is allowed to vary across sectors, so that when productivity in the final-good sector rises in the commodity country, it actually shifts labor out of the more productive export sector and into the (less traded) consumption good, lowering its price and therefore the real exchange rate. The potential role of differences in labor productivity across sectors that are highlighted in our model could be one of the reasons why empirical ev-

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idence for the Balassa-Samuelson effect is somewhat mixed (see Rogoff (1996) and references therein).

Since our model features a single consumable good and a cost to transporting this good between countries, it shares elements with classic models of international finance such as Dumas (1992). In these models exchange rates, which are driven by shocks to capital productivities in the (ex ante symmetric) countries, vary in a region where no trade occurs due to the proportional trade cost. The less productive country (importing the good) has a higher interest rate and its currency earns a positive risk premium, but the bulk of the interest rate differential is driven by the expected currency depreciation while the risk premium is generally small and behaves highly nonlinearly. Indeed, Hollifield and Uppal (1997) show that a model of this class cannot satisfy the Fama (1984) condition that the volatility of the currency risk premium must be larger than the volatility of expected currency depreciation, which is necessary to reproduce the forward premium puzzle. This condition is satisfied trivially in our model since the real exchange rate has zero drift, and consequently the risk premium accounts for the entirety of the instantaneous interest rate differential.

The contrast with the Dumas (1992) model also highlights the importance of our formulation of trade costs. The classic iceberg cost approach, where a constant proportion of exports is lost, implies a no-trade region within which real exchange rates vary (reflecting the fluctuations in the relative marginal utilities of the two countries); outside of this region the exchange rate is constant since once it becomes optimal to ship (finished) goods from the producer to the consumer country, the marginal utilities are proportional to each other. This is clearly counterfactual since empirically both exports and exchange rates vary in the presence of trade, even at relatively high frequencies (even for pegged currencies real exchange rates vary due to inflation). The latter is captured by our specification where the iceberg rate starts at zero and increases with the amount of exports. While the specific functional form of the trade cost function τ that we use is of no particular importance, one could imagine more general formulations, such as a linear function with a non-zero intercept, capturing some fixed costs of exports. This would combine a no-trade region with a region of increasingly costly trade, so that the real exchange rates are never constant. We leave such extensions to future work.

II. General Model

We start with a complete setup where two countries can produce both goods. Countries are indexed by j and goods by $i \in \{c, f\}$. Each country has a commodity-producing sector and a final-good-producing sector that share a country-specific labor supply normalized to one: $l_{jc} + l_{jf} = 1$. Productivity is both sector- and country-specific, that is, $z_{ji} > 0$, for all i, j. Intra-country wages paid in each sector are linked by the commodity price, p_j, the price of the commodity in units of the final good:

$$w_{jc} p_j = w_{jf}. \tag{IA1}$$

Profits in the commodity sector are given by a linear technology,

$$\pi_{jc} = \underbrace{z_{jc} l_{jc}}_{\doteq y_{jc}} - w_{jc} l_{jc}, \tag{IA2}$$

whereas the final-good sector features Cobb-Douglas production parameterized by a country-specific commodity factor share α_j,

$$\begin{aligned} \pi_{jf} = & \underbrace{z_{jf}(y_{jc} + x(1-\tau_c(x,z_k))\mathbf{1}_{\text{Importing}} - x\mathbf{1}_{\text{Exporting}})^{\alpha_j} l_{jf}^{1-\alpha_j}}_{\doteq y_{jf}} \\ & - p_j(y_{jc} + x(1-\tau_c(x,z_k))\mathbf{1}_{\text{Importing}} - x\mathbf{1}_{\text{Exporting}}) - w_{jf} l_{jf}, \end{aligned} \tag{IA3}$$

where x is the quantity of commodity traded, the indicator function $\mathbf{1}$ selects whether the commodity is importing or exporting, and $\tau_c(x, z_k)$ is the trade cost on the commodity, a function that increases in the quantity of exports and decreases in the stock of global shipping capacity z_k, which is specified exogenously and follows a stochastic process that is cointegrated with a particular country j's final-good productivity z_{jf}. Previous work that we carried out suggests that an extension where shipping investment and capital are chosen endogenously does not change the model's main qualitative predictions.

For now, call one country the producer country, denote it by p, and give it the (relative) Pareto weight λ; call the other country the commodity country and denote it by c. The reason for the choice of names will become clear. The planner chooses both countries' commodity labor supplies, commodity exports x, and final-good exports X to maximize Pareto-weighted utility under a strictly concave utility function $u(c) = (c^{1-\gamma} - 1)/(1-\gamma)$. More formally, given a set of adapted stochastic processes $\{z_{pft}, z_{cft}, z_{kt}\}_{t\geq 0}$, the planner's problem at each date t is

$$V(z_{pft}, z_{cft}, z_{kt}) = \max_{\{X_s, x_s, l_{cps}, l_{ccs}\}_{s\geq t}} \mathbb{E}_t \left[\int_t^\infty e^{-\rho(s-t)} \left(\frac{c_{cs}^{1-\gamma} - 1}{1-\gamma} + \lambda \frac{c_{ps}^{1-\gamma} - 1}{1-\gamma} \right) ds \right] \tag{IA4}$$

s.t.

$$c_{cs} = z_{cfs}(z_{ccs} l_{ccs} + (x_s(1-\tau_c(x_s, z_{ks}))\mathbf{1}^p_{ex} - x_s \mathbf{1}^p_{im}))^{\alpha_c} l_{cfs}^{1-\alpha_c} - \mathbf{1}^p_{IM} X_s + \mathbf{1}^p_{EX} X_s (1-\tau_f(X_s, z_{ks})) \tag{IA5}$$

$$c_{ps} = z_{pfs}(z_{pcs} l_{pcs} + (x_s(1-\tau_c(x_s, z_{ks}))\mathbf{1}^p_{im} - x_s \mathbf{1}^p_{ex}))^{\alpha_p} l_{pfs}^{1-\alpha_p} - \mathbf{1}^p_{EX} X_s + \mathbf{1}^p_{IM} X_s (1-\tau_f(X_s, z_{ks})) \tag{IA6}$$

$$1 = l_{ccs} + l_{cfs} \tag{IA7}$$

$$1 = l_{pcs} + l_{pfs}, \tag{IA8}$$

where $\mathbf{1}^p_{ex}$ and $\mathbf{1}^p_{im}$ are indicator functions for when the producer country exports or imports the commodity and $\mathbf{1}^p_{EX}$ and $\mathbf{1}^p_{IM}$ for when it exports or imports the final good.

Because the production economy is essentially static, the planner's problem collapses to a sequence of one-period problems and thus we ignore time subscripts. Importantly, both types of trade are subject to a convex trade cost, making the marginal cost of an additional shipped good increasing in the amount of trade:

$$\frac{\partial \tau_c(x, z_k)}{\partial x} > 0 \qquad \text{and} \qquad \frac{\partial \tau_f(X, z_k)}{\partial X} > 0. \tag{IA9}$$

The first-order conditions are

$$\frac{\partial}{\partial l_{cc}} : l_{cc} = \alpha_c - (1-\alpha_c)\frac{x(1-\tau_c(x,z_k))\mathbf{1}^p_{ex} - x\mathbf{1}^p_{im}}{z_{cc}} \tag{IA10}$$

$$\frac{\partial}{\partial l_{pc}} : l_{pc} = \alpha_p - (1-\alpha_p)\frac{x(1-\tau_c(x,z_k))\mathbf{1}^p_{im} - x\mathbf{1}^p_{ex}}{z_{cc}} \tag{IA11}$$

$$\begin{aligned}\frac{\partial}{\partial x} :\ & u'(c_c)\frac{\alpha_c y_{cf}}{z_{cc}l_{cc} + (x(1-\tau_c(x,z_k))\mathbf{1}^p_{ex} - x\mathbf{1}^p_{im})} \cdot \frac{\partial}{\partial x}(x(1-\tau_c(x,z_k))\mathbf{1}^p_{ex} - x\mathbf{1}^p_{im}) \\ & + \lambda u'(c_p)\frac{\alpha_p y_{pf}}{z_{pc}l_{pc} + (x(1-\tau_c(x,z_k))\mathbf{1}^p_{im} - x\mathbf{1}^p_{ex})} \cdot \frac{\partial}{\partial x}(x(1-\tau_c(x,z_k))\mathbf{1}^p_{im} - x\mathbf{1}^p_{ex}) = 0\end{aligned} \tag{IA12}$$

$$\frac{\partial}{\partial X} : u'(c_c)\frac{\partial}{\partial X}\left(X\left(1-\tau_f(X,z_k)\right)\mathbf{1}^p_{EX} - X\mathbf{1}^p_{IM}\right) + \lambda u'(c_p)\frac{\partial}{\partial X}\left(X\left(1-\tau_f(X,z_k)\right)\mathbf{1}^p_{IM} - X\mathbf{1}^p_{EX}\right) = 0. \tag{IA13}$$

Plugging (IA10) and (IA11) into (IA12) gives

$$\begin{aligned}& u'(c_c)z_{cf}z_{cc}^{\alpha_c-1}\alpha_c^{\alpha_c}(1-\alpha_c)^{1-\alpha_c}\frac{\partial}{\partial x}(x(1-\tau_c(x,z_k))\mathbf{1}^p_{ex} - x\mathbf{1}^p_{im}) \\ & + \lambda u'(c_p)z_{pf}z_{pc}^{\alpha_p-1}\alpha_p^{\alpha_p}(1-\alpha_p)^{1-\alpha_p}\frac{\partial}{\partial x}(x(1-\tau_c(x,z_k))\mathbf{1}^p_{im} - x\mathbf{1}^p_{ex}) = 0.\end{aligned} \tag{IA14}$$

Our definition of the real exchange rate, the price of producer-country consumption per unit of commodity-country consumption, is

$$S \doteq \frac{u'(c_c)}{\lambda u'(c_p)}. \tag{IA15}$$

Using this in (IA14) gives the expression

$$S = -\frac{z_{pf}z_{pc}^{\alpha_p-1}\alpha_p^{\alpha_p}(1-\alpha_p)^{1-\alpha_p}\frac{\partial}{\partial x}(x(1-\tau_c(x,z_k))\mathbf{1}^p_{im} - x\mathbf{1}^p_{ex})}{z_{cf}z_{cc}^{\alpha_c-1}\alpha_c^{\alpha_c}(1-\alpha_c)^{1-\alpha_c}\frac{\partial}{\partial x}(x(1-\tau_c(x,z_k))\mathbf{1}^p_{ex} - x\mathbf{1}^p_{im})} \doteq \frac{p_p}{p_c}, \tag{IA16}$$

where we define the country-specific commodity prices (which are linked by the law of one price) with the last equation. We should emphasize here that the exchange rate is driven by relative productivities, our paper's focus. Also, each country's commodity price is determined by the relative productivity of both sectors within each country. Thus, productivities, commodity prices, exchange rates, and currency returns are all linked together by this condition.

At this point, we cannot solve the model in closed-form because of the presence of a trade cost on the commodity. We discuss the implications of including a commodity trade cost later in the Internet Appendix, partially referencing analysis we have done with a commodity trade cost in a companion paper (Ready, Roussanov, and Ward (2017)) that shows that the commodity trade cost does not change the model's main qualitative predictions. To proceed, we relax this friction and specify $\tau_c(\cdot) \equiv 0$.

Model Symmetry around $z_{cf} = z_{pf}$

To analyze the model's symmetry, we specify a *fully symmetric setup* that has $\lambda = 1$, identical Cobb-Douglas production function parameters $\alpha_p = \alpha_c$, identical commodity productivities $z_{pc} = z_{cc}$, a quadratic trade cost on the final good $\tau_f(X, z_k) = \frac{\kappa}{2}\frac{X}{z_k}$, and no commodity trade cost. We then have the exchange rate

$$S = \frac{1}{z}, \tag{IA17}$$

where $z = z_{cf}/z_{pf}$, and the quantity of final-good exports X solves

$$S \times \left[\left(1 - \kappa\frac{X}{z_k}\right) \mathbf{1}^p_{EX} - \mathbf{1}^p_{IM} \right] + \left[\left(1 - \kappa\frac{X}{z_k}\right) \mathbf{1}^p_{IM} - \mathbf{1}^p_{EX} \right] = 0. \tag{IA18}$$

We arrive at the following lemma.

LEMMA IA1: *At $z = 1$, both countries do not trade because they are identical and allocations are Pareto optimal.*

Proof. If $z = 1$, then (IA18) can hold only if there is no trade in the final good: $X = 0$. If there is no trade in final goods, then a country's domestic consumption is determined only by domestic commodity production and commodity trade. Plugging (IA10) and (IA11) into each country's production function gives the consumption for each country

$$c_c = z_{cf}\phi_c(z_{cc} + (x\mathbf{1}^p_{ex} - x\mathbf{1}^p_{im})) \qquad \text{and} \qquad c_p = z_{pf}\phi_p(z_{pc} + (x\mathbf{1}^p_{im} - x\mathbf{1}^p_{ex})), \tag{IA19}$$

where $\phi_j = z_{jc}^{\alpha_j - 1}\alpha_j^{\alpha_j}(1-\alpha_j)^{1-\alpha_j}$. If consumption is purely from domestic commodity production, we get

$$c^*_j = z_{jf}\phi_j z_{jc}, \text{ for all } j, \tag{IA20}$$

where by symmetry ($\phi_p z_{pc} = \phi_c z_{cc}$) we have $c^*_p = c^*_c$.

For a contradiction, suppose that it is optimal to ship some quantity of the commodity from the commodity country to the producer country; call this quantity $\hat{x} > 0$. We can now define consumptions as

$$\hat{c}_p = c^*_p + z_{pf}\phi_p\hat{x} \qquad \text{and} \qquad \hat{c}_c = c^*_c - z_{cf}\phi_c\hat{x}. \tag{IA21}$$

Then by the strict concavity of the utility function, the maximization problem would be

$$\frac{1}{2}\left(u(\hat{c}_c) + u(\hat{c}_p)\right) < u\left(\frac{\hat{c}_c}{2} + \frac{\hat{c}_p}{2}\right) = u(c^*_p), \tag{IA22}$$

which contradicts the optimality of exporting the commodity. Therefore, $x = 0$ is the optimal allocation at $z = 1$. ∎

As a consequence of the lemma, consider the following. With relative productivity $z < 1$, the optimal allocations are $\{X, x, l_{cc}, l_{pc}, c_c, c_p\}$. If we define $\hat{z} = 1/z > 1$, then the model is *allocation symmetric* around the point $z = 1$ in the following sense: the commodity country is now more productive at producing the final good and therefore imports the commodity from the producer country, repaying it with the final good, such that

- $\hat{X} = X$
- $\hat{x} = x$
- $\hat{l}_{pc} = l_{cc}$
- $\hat{l}_{cc} = l_{pc}$
- $\hat{c}_p = c_c$
- $\hat{c}_c = c_p$
- $\hat{S} = 1/S = z = 1/\hat{z}$.

Intuitively, the countries' roles switch although all quantities and prices are identical. In essence, restricting the support of final-good productivities, $z_{pf} \geq z_{cf}$, is without loss of generality: the two countries' names are simply interchanged and the planner faces the same intratemporal problem every period.

Introduce Single Asymmetry and Main Model Results

We introduce our first asymmetry by making relative productivity z stochastic with support below one. Thus, by varying z away from one, one country becomes relatively better at producing the final good and as a result our model's main predictions come to bear. We label the country that is relatively better at producing the final good the producer country and the other country the commodity country. This choice emphasizes that final-good productivities drive the model's main economic mechanism, which is consistent with our view that final-good productivity drives the global business cycle. It also highlights the fact that even though the commodity country is less productive at producing the final good, this does not diminish its ability to reallocate resources to produce more of the commodity for export. Indeed, its choice to allocate a larger fraction of labor to commodity production is precisely why we call the country the commodity country.

Because of the presence of trade costs, it will be optimal to ship final goods one way and commodities the other. In particular, optimal risk-sharing will have the Planner ship some of the commodity country's commodity to the producer country, which will ship back final goods in repayment. As a result, in equilibrium the trade cost on the final good endogenizes risk-sharing between the two countries. More specifically, during good times when z_{pf} is high relative to z_{cf}, there will be a lot of trade between the two countries. Because the marginal trade cost is increasing in trade, the difference between the two countries' consumptions will grow as well. The producer country consumes relatively more as its relative productivity increases, and conversely its relative consumption drops faster as its relative productivity falls.

We can now solve for final-good exports, commodity exports, and both countries' consumptions:[1]

$$X = (1-z)\frac{z_{pf}}{\kappa} \tag{IA23}$$

$$x = \frac{(zz_{cc} + \frac{X}{\phi_p z_{pf}}(1-\tau_f(X, z_{pf})))\omega(z) + \frac{X}{\phi_p z_{pf}} - z_{pc}}{1 + z\omega(z)} \tag{IA24}$$

$$c_c = z_{cf}\frac{\phi_c(z_{cc} + z_{pc}) + \frac{1}{2\kappa}\frac{(1-z)^2}{z}}{1 + \omega(z)z} \tag{IA25}$$

$$c_p = c_c\omega(z), \tag{IA26}$$

where our consumption wedge (with $\lambda = 1$) is $\omega(z) = (z)^{-\frac{1}{\gamma}}$, which is decreasing in z.

By only allowing final-good relative productivity to differ between countries, the model generates a positive risk premium on the carry trade from the perspective of the producer country's consumer. To see this, we differentiate c_c with respect to z, which gives

$$\frac{\partial c_c}{\partial z} = z_{cf}\frac{\frac{1}{2\kappa}(-\frac{1}{z^2} + 1)(1 + \omega(z)z) - (\phi_c(z_{cc} + z_{pc}) + \frac{1}{2\kappa}\frac{(1-z)^2}{z})\omega(z)(1 - \frac{1}{\gamma})}{(1 + \omega(z)z)^2} < 0, \tag{IA27}$$

because $z^2 < 1$ and $\gamma \geq 1$. Showing that

$$\frac{\partial S}{\partial z} < 0 \tag{IA28}$$

is trivial, and because $\omega'(z) < 0$ (and $c_c > 0$ and $\omega(z) > 0$), it follows that

$$\frac{\partial c_p}{\partial z} < 0. \tag{IA29}$$

Therefore, the exchange rate and both consumption levels are monotone decreasing in relative final-good productivity. As a consequence changes in the producer country's marginal utility comove negatively with changes in the real exchange rate, and so it will command a positive risk premium. In contrast, changes in the commodity country's marginal utility are positively related to changes in $1/S$. In equilibrium, the exchange rate from the commodity-country investor's perspective is a hedge to declines in global productivity, as the producer country's currency appreciates in bad times. Therefore, in equilibrium the commodity-country investor earns a negative risk premium.

If the growth of the real exchange rate has zero drift, as we show in the paper, then conditional interest rate differentials must equal this conditional risk premium (with CRRA preferences and complete markets).

Our definition of import ratios, where we add commodity exports and final-good imports but subtract commodity imports and final-good exports, places the commodity country on

[1]As before, we require a parametric bound to ensure that commodity production exceeds commodity exports ($x < z_{cc} = z_{pc}$), that is, we must have $2\kappa\alpha^\alpha(1-\alpha)^{1-\alpha}z_{cc}^\alpha > (1-\underline{z})(1 + (1-\underline{z})\omega(\underline{z})/2)$. However, the bound does not require solving a fixed point as in the paper because X is not a function of commodity productivity $\{z_{jc}\}$.

the positive orthant and the producer country on the negative orthant. Thus, a trading strategy formed on the basis of import ratios where positive ratios are bought and negative ratios sold would produce a spread in interest rates and risk premia.

We next take the general model described above while imposing $z < 1$. We then sequentially make restrictions to bring the general model to the original model in the paper, and we discuss after how a trade cost on the commodity affects the results.

Relating the General Model to the Paper's Original Model

Without assuming the *fully symmetric setup* but with $z < 1$ we can write our real exchange rate in (IA16) as

$$S = \frac{z_{pf}}{z_{cf}} \frac{z_{pc}^{\alpha_p - 1} \alpha_p^{\alpha_p} (1-\alpha_p)^{1-\alpha_p} \frac{\partial}{\partial x}(x(1-\tau_c(x, z_k)))}{z_{cc}^{\alpha_c - 1} \alpha_c^{\alpha_c} (1-\alpha_c)^{1-\alpha_c}} \doteq \frac{p_p}{p_c}, \tag{IA30}$$

which now highlights the direction of the commodity trade—from commodity country to producer country.

At this point the model's main predictions come to bear. To see this, if z_{pf} increases (good global times), both the exchange rate and the producer country's commodity price appreciate. But when z_{pf} falls, the return on a currency carry trade that is long the commodity country would be negative. As before, there would therefore be a positive risk premium on a carry trade demanded by the producer country's investor (the investor's consumption falls in bad times with the currency return).

Plugging (IA30) into (IA13) yields

$$X = \left(1 - \frac{z_{cf}}{z_{pf}} \frac{z_{cc}^{\alpha_c - 1} \alpha_c^{\alpha_c} (1-\alpha_c)^{1-\alpha_c}}{z_{pc}^{\alpha_p - 1} \alpha_p^{\alpha_p} (1-\alpha_p)^{1-\alpha_p} \frac{\partial}{\partial x}(x(1-\tau_c(x, z_k)))}\right) \frac{z_k}{\kappa}, \tag{IA31}$$

which in this instance is a function of x. It should be clear that relaxing the friction on the commodity's trade cost enables us to solve the model in closed-form: X ceases to be a function of x. We make this assumption here, $\tau_c \equiv 0$, which gives the real exchange rate the form

$$S = \frac{z_{pf}\phi_p}{z_{cf}\phi_c} \doteq \frac{p_p}{p_c}, \tag{IA32}$$

and we can now analyze the assumptions that we make to get back to the original model presented in the main text.

It turns out that having shipping capacity be perfectly cointegrated with the producer country's final-good productivity does not to matter for the model's qualitative features because the planner's problem is strictly intratemporal, and so in the main text we impose $z_k = z_{pf}$. However, it does matter for interpreting results on predictability, as seen in Table IAX. We conduct a quantitative evaluation of this restriction in Ready, Roussanov, and Ward (2017).

Final-good exports then become

$$X = \left(1 - \frac{z_{cf} z_{cc}^{\alpha_c - 1} \alpha_c^{\alpha_c} (1-\alpha_c)^{1-\alpha_c}}{z_{pf} z_{pc}^{\alpha_p - 1} \alpha_p^{\alpha_p} (1-\alpha_p)^{1-\alpha_p}}\right) \frac{z_{pf}}{\kappa}. \tag{IA33}$$

We are now one restriction away from our original model. If we simply define a new stochastic process as $z_p \doteq z_{pf}\phi_p$, we are back to the original model. We found it clearer, however, to shut down commodity production in the producer country and let our regulated process for $z = z_{cf}/z_{pf}$ (and geometric diffusion dynamics for z_{cf}) determine the dynamics of z_{pf}. In either case we end up with

$$X = (1 - \phi_c z)\frac{z_{pf}}{\kappa}. \tag{IA34}$$

Specifically, our original model's setup imposes $z_{pc} = 0$. Recall that we also had $p^* = z_{pf}$ from the decentralized production choice of the producer country. Because of this, extending the model so that the producer country has a commodity sector does not change the qualitative predictions of the model, which is pinned down by our equilibrium condition in (IA16).

The Effects of Varying Commodity Productivity and Commodity Trade Costs

At this point it is worth commenting on how commodity productivity and a trade cost on commodity trade would affect the model's exchange rate. For clarity we specify here identical Cobb-Douglas parameters $\alpha_c = \alpha_p$ and a quadratic trade cost $\tau_j(a, b) = \frac{\kappa_j a}{2b}$, rewriting (IA16) as

$$S = \frac{z_{pf}}{z_{cf}} \left(\frac{z_{cc}}{z_{pc}}\right)^{1-\alpha} \left(1 - \kappa_c \frac{x}{z_k}\right). \tag{IA35}$$

An increase in relative commodity productivity of the commodity country, z_{cc}/z_{cp}, would now have two effects on the exchange rate. The first effect is to lower the relative marginal product of the commodity in the commodity country. Consequently, labor would flow marginally towards commodity production, thus lowering its domestic price, and as a result final-good production would shrink, increasing the commodity country's marginal utility and pushing up the exchange rate. This mechanism is similar to the "global good times" effect whereby an increase in relative productivity pushes up the commodity country's exchange rate.

The second effect holds when the marginal trade cost of the commodity increases. As commodity exports increase, the exchange rate actually falls. As the commodity country continues to export more, the marginal value of an extra unit of the commodity declines, and therefore the price of the commodity country's exchange rate falls. These two effects partially offset each other and determining which effect dominates depends on the model parameters and specification.

The commodity trade friction would also affect two other model predictions. First, it would increase the allocation of labor to commodity production in the *producer* country when importing the commodity: $l_{pc}|_{\text{Importing}\, x, \tau_c(\cdot)=0} < l_{pc}|_{\text{Importing}\, x, \tau_c(\cdot) \in (0,1)}$. Second, whether the variance of the commodity price would increase or decrease depends on the joint covariance matrix of $\{z_{jf}\}$ and x. Neither of these choices affect the primary economic mechanism so we abstract from the commodity trade cost for clarity: $\tau_c(\cdot) = 0$. Reassuringly, we generate similar carry trade phenomena when we look at the case in which commodity exports are affected by trade costs in Ready, Roussanov, and Ward (2017).

III. Data and Robustness

A. Pairwise Returns

To show that the trading strategies are both unconditional in nature and not driven by any one currency pair, we report the returns of currency pairs for each combination of short a final-good-producer currency and long a commodity-country currency, as well as portfolios of all commodity countries or all producer countries. Table IAI shows the results.

B. Classification of Goods

We assign individual goods to "Basic" (input) and "Complex" (finished) groups based on the descriptions of four-digit SITC (Revision 4) categories available from the UN. Earlier data using previous SITC revisions is classified via concordance tables. Table IAII presents classifications aggregated at the two-digit SITC level, and shows the number of four-digit sub-categories falling into the two groups. A detailed breakdown is available upon request.

C. Currency Strategies and Transaction Costs

We investigate the effect of transaction costs on the profitability of trading strategies based on the combined export-import sort. We use bid-ask quotes for forward and spot exchange rates from Reuters. Lyons (2001) reports that bid and ask quotes published by Reuters imply bid-ask spreads that are approximately twice as large as actual inter-dealer spreads. We assume that net excess returns take place at these quotes. As a result, our estimates of transaction costs are conservative, at least from the standpoint of a large financial institution. Since our strategy is based on sorting currencies using trade data that are available at an annual frequency, a natural approach for minimizing the transaction costs is to use one-year forward contracts. We therefore compute returns on rolling one-year forward contracts, but to avoid the arbitrary choice of starting month, we construct the portfolio returns at a monthly frequency (i.e., use overlapping yearly returns). Table IAIII presents the average depreciation of the currencies in each portfolio, average (log) forward discount, and average excess returns with and without bid-ask spreads applied.

D. G10 Import Ratios

To illustrate the unconditional nature of the import ratio measure, Panel A of Figure **??** plots the variable for each of the G10 countries. As the figure shows, the sorting on this variable is extremely persistent. The four commodity countries of Australia, Canada, New Zealand, and Norway have the highest ratios over the entire sample, and the four producer countries of Germany, Japan, Sweden, and Switzerland have the lowest. Panel B plots the

Table IAI
Pairwise Currency Strategy Returns

This table presents excess mean returns and Sharpe ratios on pairwise and portfolio trading strategies for G10 commodity and final-producer currencies. Returns are calculated using monthly forward returns for a strategy going long a commodity- country currency (Australia, Canada, Norway, and New Zealand, or an equal weighted portfolio of all four), and short a producer-country currency (Europe or the German Deutschmark pre-1999, Japan, Sweden, Switzerland, or an equal-weighted portfolio). White (1980) standard errors are in parentheses. Data are monthly from 01/1988 to 04/2013. Returns do not include transaction costs. ***, **, and * indicate statistical significance at the 1%, 5%, and the 10% level, respectively.

		Short Leg				
Long Leg		Europe / Germany	Japan	Sweden	Switzer-land	Producer Country Portfolio
Australia	Return	3.90	5.22*	3.20	4.25	4.14*
	SE	(2.41)	(3.10)	(2.34)	(2.68)	(2.33)
	SR	0.09	0.10	0.08	0.09	0.10
Canada	Return	1.82	3.14	1.12	2.17	2.06
	SE	(2.21)	(2.71)	(2.16)	(2.47)	(2.04)
	SR	0.05	0.07	0.03	0.05	0.06
Norway	Return	2.14*	3.46	1.44	2.49	2.38*
	SE	(1.23)	(2.66)	(1.36)	(1.62)	(1.31)
	SR	0.10	0.07	0.06	0.09	0.11
New Zealand	Return	3.77*	5.09*	3.07	4.12*	4.01*
	SE	(2.18)	(2.89)	(2.22)	(2.35)	(2.08)
	SR	0.10	0.10	0.08	0.10	0.11
Commodity Country Portfolio	Return	2.91*	4.22	2.21	3.26*	3.15**
	SE	(1.64)	(2.56)	(1.64)	(1.96)	(1.54)
	SR	0.10	0.10	0.08	0.10	0.12

Table IAII
COMTRADE Goods Classification

This table presents rows which correspond to a two-digit Standard International Trade Classification category according to SITC Rev. 4. The classification columns show the number of four-digit subcategories classified as a Basic or Complex good. Descriptions are from the UN Statistics Division.

		Sub-categories classified as	
SITC	Description	Basic	Complex
00	Live animals	13	2
01	Meat and meat preparations	14	0
02	Dairy products and eggs	10	0
03	Fish and fish preparations	12	0
04	Cereals and cereal preparations	24	0
05	Fruit and vegetables	25	1
06	Sugar, sugar preparations and honey	4	4
07	Coffee, tea, cocoa, spices and manufacs. thereof	10	5
08	Feed. Stuff for animals excl. Unmilled cereals	6	0
09	Miscellaneous food preparations	5	0
11	Beverages	0	7
12	Tobacco and tobacco manufactures	4	4
21	Hides, skins and fur skins, undressed	9	0
22	Oil seeds, oil nuts and oil kernels	14	0
23	Crude rubber including synthetic and reclaimed	5	0
24	Wood, lumber and cork	14	0
25	Pulp and paper	0	7
26	Textile fibres, not manufactured, and waste	32	0
27	Crude fertilizers and crude minerals, nes	23	0
28	Metalliferous ores and metal scrap	22	0
29	Crude animal and vegetable materials, nes	11	0
32	Coal, coke and briquettes	8	0
33	Petroleum and petroleum products	2	11
34	Gas, natural and manufactured	0	4
35	Electric energy	0	2
41	Animal oils and fats	3	0
42	Fixed vegetable oils and fats	14	0
43	Animal and vegetable oils and fats, processed	5	0
51	Chemical elements and compounds	0	28
52	Crude chemicals from coal, petroleum and gas	0	14
53	Dyeing, tanning and colouring materials	0	11
54	Medicinal and pharmaceutical products	0	8
55	Perfume materials, toilet and cleansing preptions	0	9
56	Fertilizers, manufactured	0	5
57	Explosives and pyrotechnic products	0	4
58	Plastic materials, etc.	0	28
59	Chemical materials and products, nes	0	13
61	Leather, lthr. Manufs., nes and dressed fur skins	9	5
62	Rubber manufactures, nes	2	10
63	Wood and cork manufactures excluding furniture	2	12
64	Paper, paperboard and manufactures thereof	0	15
65	Textile yarn, fabrics, made up articles, etc.	0	58
66	Non metallic mineral manufactures, nes	0	39
67	Iron and steel	8	26
68	Non ferrous metals	26	0
69	Manufactures of metal, nes	0	32
71	Machinery, other than electric	0	25
72	Electrical machinery, apparatus and appliances	0	36
73	Transport equipment	0	10
81	Sanitary, plumbing, heating and lighting fixt.	0	4
82	Furniture	0	4
83	Travel goods, handbags and similar articles	0	2
84	Clothing	0	35
85	Footwear	0	2
89	Miscellaneous manufactured articles, nes	0	39
94	Animals, nes, incl. Zoo animals, dogs and cats	2	0
95	Firearms of war and ammunition therefor	0	2

Table IAIII
One-Year Returns on Import-Export Sorted Portfolios, All Countries

This tables one-year returns on portfolios sorted by import-export statistics. Portfolios are rebalanced annually. Reported returns are sampled monthly with overlap. The data are from 1/1988 to 12/2012.

Portfolio	1	2	3	4	5	6
			Spot Change: Δs^j (without b-a)			
Mean	0.08	−0.37	−1.03	0.37	1.33	−0.50
Std	6.77	9.90	9.36	8.87	9.19	9.14
			Forward Discount: $f^j - s^j$			
Mean	−0.48	1.29	1.15	1.99	2.19	2.23
Std	1.87	2.19	2.39	2.29	1.32	1.63
			Log Excess Return: rx^j (without b-a)			
Mean	−0.56	1.66	2.18	1.61	0.86	2.73
Std	7.29	9.93	9.15	8.99	9.45	9.18
SR	−0.08	0.17	0.24	0.18	0.09	0.30
			Excess Return: rx^j (without b-a)			
Mean	0.01	2.32	2.80	2.29	1.62	3.38
Std	7.09	9.93	9.42	8.87	9.80	9.39
SR	0.00	0.23	0.30	0.26	0.17	0.36
			Net Excess Return: rx^j_{net} (with b-a)			
Mean	0.27	2.07	2.61	2.08	1.40	3.17
Std	7.16	9.93	9.39	8.84	9.78	9.38
SR	0.04	0.21	0.28	0.24	0.14	0.34
			High-minus-Low: rx^j_{net} (without b-a)			
Mean		2.31	2.79	2.28	1.61	3.37
Std		6.57	6.58	5.93	7.59	6.96
SR		0.35	0.42	0.38	0.21	0.48
			High-minus-Low: $rx^j_{net} - rx^1_{net}$ (with b-a)			
Mean		1.80	2.34	1.81	1.13	2.90
Std		6.58	6.58	5.95	7.60	6.92
SR		0.27	0.36	0.30	0.15	0.42

time series of forward discounts relative to the U.S. dollar. While there is more variation in this variable, the sort is still quite persistent, with the commodity countries usually having higher values.

E. Panel Regressions of Forward Discounts on Import Ratios

One concern with cross-sectional empirical tests of forward discounts on various predictor variables is the high degree of persistence in both the independent and the dependent variables of the Fama-Macbeth regressions shown in Table II in the text. While the regressions attempt to control for serial correlation of the error terms by using robust standard errors, here we take the more aggressive approach and estimate panel regressions in which the monthly data are aggregated up to four roughly equal six-year periods (1988 to 1993, 1993 to 1999, 2000 to 2006, 2007 to 2013). We then estimate regressions of forward discounts on the various explanatory variables under two specifications. In the first we estimate the regressions with standard errors clustered by period. In the second we include period fixed-effects. Table IAIV reports the results. We still find a strong relation between the import ratio measures and both forward discounts.

F. Relative Exchange and Interest Rates vs. Manufacturing Output

A primary implication of the model is that the relative productivity levels in the complex goods sector drive the real exchange rate and the interest rate differential of the two countries. In the main text, we proxy for this level of productivity using aggregate economic labor productivity for the two economies. Here we report regressions using quarterly changes in the quantity index of "Production in total manufacturing" reported by the OECD. Tables IAV and IAVI report the results for exchange rates and interest rates, respectively. As the tables show, the results using this proxy provide additional support for the model mechanism, and if anything are stronger than the results using aggregate productivity.

G. Cross-Sectional Asset Pricing Tests

In Tables IAVII and IAVIII we report the standard cross-sectional asset pricing tests using the IMX factor applied on the currency portfolio sorted on the import ratio and on the currency portfolio sorted on the forward discounts, respectively.

H. Contemporaneous relations of IMX Strategy

In this section we repeat the analysis of Table V in the main text using returns to the IMX strategy in place of real exchange rates. Table IAIX reports the results. We first regress IMX returns on the relative productivity of G10 producer and commodity countries described in the main text. While the relation is slightly weaker, (the p-value is 10.5), we find qualitatively the same relation: returns to the IMX strategy are high when productivity in producer countries increases relative to commodity countries. For the variables related to commodity prices and trade costs, we find if anything stronger contemporaneous relations. IMX returns are high when trade costs and commodity prices rise, consistent with the implications of the

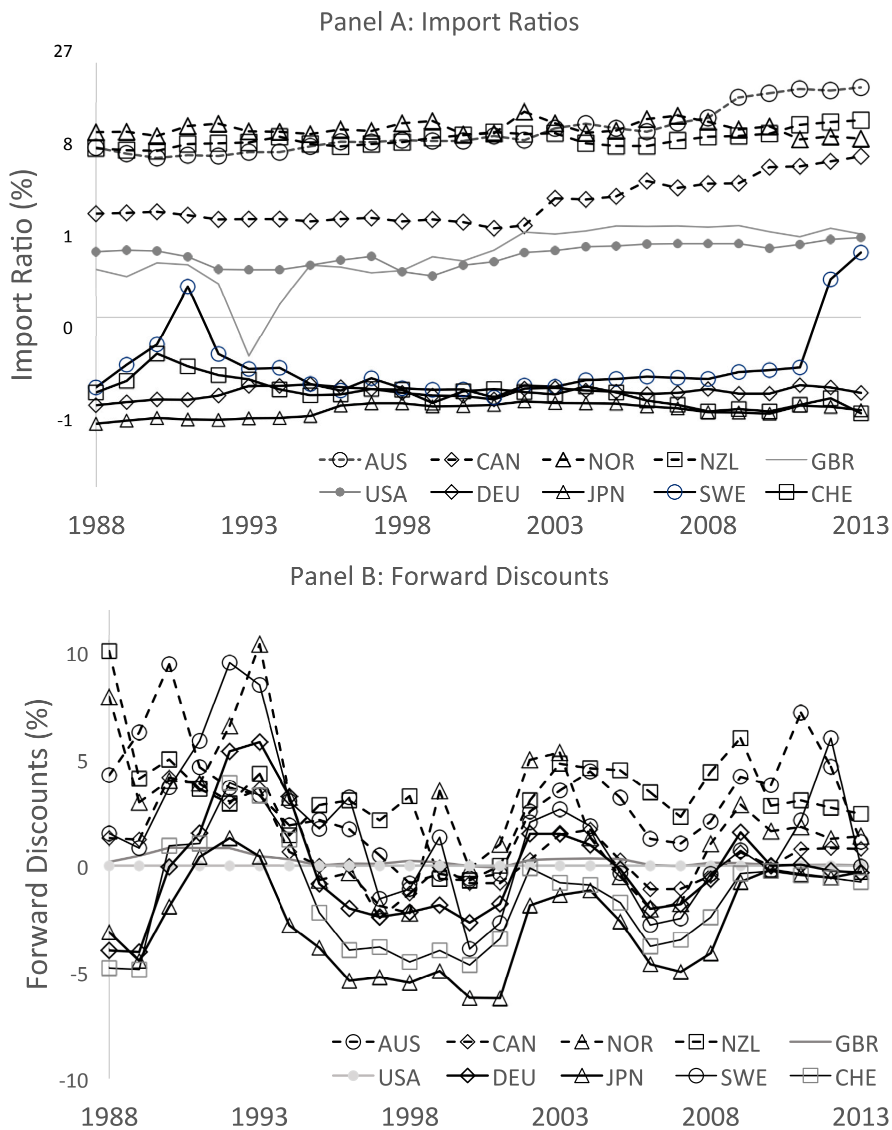

Figure IA1. G10 import ratios vs. forward discounts. This figure plots the import ratios and forward discounts for each of the G10 currencies over the sample period. The four commodity countries are plotted as dashed lines, while the four producer countries are plotted with a bold solid line. The import ratio is shown on a cubic scale for clarity. Forward discounts are end-of-year discounts on the one-month U.S. dollar forward contracts, expressed as annualized percentages.

Table IAIV
Panel Regressions of Forward Discounts on Import Ratios

This table shows panel regressions of forward discounts on the import ratio as well as the log of GDP and average inflation. Each panel is constructed by taking the average of variables over four periods: 1988 to 1993, 1994 to 1999, 2000 to 2006, 2007 to 2012. Regressions in the left-hand panels do not include fixed effects and are estimated with standard errors clustered by period. Regressions in the right panels include period fixed effects. Variable construction is as in Table II in the main text. Standard errors are reported in parentheses. **, *, and + indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A: IMF Advanced Economies

	S.E. Clustered by Period					Period Fixed Effects				
	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct
Import Ratio	0.21**		0.20**	0.15+	0.16+	0.22**		0.22**	0.14**	0.15**
	(0.02)		(0.02)	(0.05)	(0.06)	(0.05)		(0.06)	(0.04)	(0.04)
Log GDP		-0.27*	-0.09		0.12		-0.28	-0.03		0.03
		(0.08)	(0.08)		(0.08)		(0.18)	(0.17)		(0.12)
Inflation				0.30**	0.30**				0.28**	0.28**
				(0.02)	(0.02)				(0.04)	(0.04)
Constant	0.23	4.30+	1.39	-2.00*	-3.69	0.22	4.36+	0.60	-1.82**	-2.25
	(0.77)	(1.73)	(1.79)	(0.56)	(1.64)	(0.25)	(2.36)	(2.36)	(0.32)	(1.71)
Obs.	66	66	66	66	66	66	66	66	66	66
R^2	0.16	0.03	0.16	0.60	0.61	0.22	0.04	0.22	0.61	0.61
Periods	4	4	4	4	4	4	4	4	4	4

Panel B: G10 Currencies

	S.E. Clustered by Period					Period Fixed Effects				
	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct	Fwd Dsct
Import Ratio	0.22**		0.17+	0.15*	0.13+	0.23**		0.19**	0.15**	0.12*
	(0.02)		(0.07)	(0.04)	(0.05)	(0.05)		(0.06)	(0.05)	(0.05)
Log GDP		-0.65*	-0.36		-0.09		-0.63**	-0.26		-0.21
		(0.20)	(0.32)		(0.07)		(0.18)	(0.19)		(0.16)
Inflation				0.29**	0.28**				0.24**	0.23**
				(0.04)	(0.04)				(0.07)	(0.07)
Constant	0.15	9.72+	5.28	-1.81+	-0.55	0.11	9.48**	3.75	-1.47**	1.54
	(0.87)	(3.35)	(5.32)	(0.72)	(1.61)	(0.28)	(2.43)	(2.68)	(0.49)	(2.39)
Obs.	40	40	40	40	40	40	40	40	40	40
R^2	0.26	0.20	0.30	0.64	0.64	0.43	0.27	0.46	0.59	0.61
Periods	4	4	4	4	4	4	4	4	4	4

Table IAV
Real Exchange Rates and Relative Manufacturing Output: G10 Countries

This table presents regressions of changes in relative manufacturing output (RM_t) on changes in real exchange rates (RER_t). Each commodity country's real exchange rate and relative productivity are calculated with respect to an equal-weighted basket of its primary trading partners among the producer countries. Germany's exchange rate is calculated using the euro after 1999. All exchange rates are converted to real terms using the relative value of the country's CPI. Relative manufacturing output is calculated as the log-difference of real manufacturing output from the OECD. Data are quarterly. Newey and West (1987) standard errors with eight lags are shown in parentheses. **, *, and + indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	Aus vs. Jap		Can vs. Ger, Jap		Nor vs Ger, Jap, Swe		NZ vs Jap	
	$\Delta RM_{t,t+1}$	$\Delta RM_{t,t+2}$	$\Delta RM_{t,t+1}$	$\Delta RM_{t,t+2}$	$\Delta RM_{t,t+1}$	$\Delta RM_{t,t+2}$	$\Delta RM_{t,t+1}$	$\Delta RM_{t,t+2}$
$\Delta RER_{t,t+1}$	0.069*	0.303**	0.151**	0.338**	0.059	0.307+	0.118*	0.244+
	(0.032)	(0.106)	(0.038)	(0.068)	(0.081)	(0.171)	(0.057)	(0.129)
Constant	-0.002	-0.005	-0.001	-0.002	0.000	-0.001	-0.003	-0.006
	(0.003)	(0.004)	(0.002)	(0.003)	(0.002)	(0.004)	(0.003)	(0.005)
Obs.	104	103	104	103	104	103	104	103
R^2	0.025	0.187	0.114	0.211	0.011	0.130	0.052	0.111

Table IAVI
Real Interest Rate Differentials and Relative Manufacturing Output: G10 Countries

This table presents regressions of relative manufacturing output (RM_t) on real interest rate differentials (RIR_t). Each commodity country's real interest rate differential and relative productivity are calculated with respect to an equal-weighted basket of its primary trading partners among the producer countries. Germany's interest rate is calculated using the euro after 1999. All nominal interest rates are converted to real terms by adjusting for predicted inflation calculated as a four-quarter moving average of CPI growth centered at the observation. Relative manufacturing output is calculated as the log-difference of real manufacturing outputs from the OECD. Data are quarterly. Newey and West (1987) standard errors with eight lags are shown in parentheses. **, *, and + indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	Aus vs. Jap		Can vs. Ger, Jap		Nor vs Ger, Jap, Swe		NZ vs Jap	
	$\Delta RM_{t,t+1}$	$\Delta RM_{t,t+2}$	$\Delta RM_{t,t+1}$	$\Delta RM_{t,t+2}$	$\Delta RM_{t,t+1}$	$\Delta RM_{t,t+2}$	$\Delta RM_{t,t+1}$	$\Delta RM_{t,t+2}$
$\Delta RIR_{t,t+1}$	2.668+	4.154+	0.282	-0.829	0.641	1.229	1.615	4.396**
	(1.361)	(2.281)	(1.241)	(2.371)	(0.990)	(2.017)	(1.457)	(1.544)
Constant	-0.002	-0.005	-0.001	-0.000	0.001	0.000	-0.002	-0.005
	(0.003)	(0.005)	(0.002)	(0.004)	(0.002)	(0.004)	(0.003)	(0.005)
Obs.	104	103	104	103	104	103	104	103
R^2	0.041	0.042	0.001	0.002	0.005	0.007	0.022	0.061

Table IAVII
Asset Pricing Tests: Portfolios Sorted by Import Ratio

This table reports asset pricing tests for various portfolios sorted on import ratios. The panel on the left reports results for all countries in our sample. The panel on the right reports results for the G10 developed countries with most widely-traded currencies. Panel A reports results from GMM and Fama and MacBeth (1973) asset pricing tests. Market prices of risk λ, the adjusted R^2, the square root of mean-squared errors $RMSE$, and the p-values of χ^2 tests on pricing errors are reported in percentage points. b denotes SDF loadings on the IMX strategy return. All excess returns are multiplied by 12 (annualized). Shanken (1992)-corrected standard errors are reported in parentheses. We do not include a constant in the second step of the Fama-MacBeth procedure. Panel B reports OLS estimates of the factor betas and alphas (pricing errors) for each of the portfolios. R^2s and p-values are reported in percentage points. The standard errors in brackets are Newey and West (1987) standard errors computed with the optimal number of lags according to Andrews (1991). The χ^2 test statistic $\alpha' V_\alpha^{-1} \alpha$ tests the null that all intercepts are jointly zero. This statistic is constructed from the Newey and West (1987) variance-covariance matrix (one lag) for the system of equations (see Cochrane (2005), p. 234). Data are monthly, from Barclays and Reuters in Datastream. The sample period is 2/1988 to 4/2013. The alphas are annualized and in percentage points.

Panel A: Risk Prices

	All Countries					G10 Countries				
	λ_{IMX}	b_{IMX}	R^2	$RMSE$	χ^2	λ_{IMX}	b_{IMX}	R^2	$RMSE$	χ^2
GMM_1	5.80	0.66	40.36	1.15		4.70	0.43	−12.59	1.58	
	[3.18]	[0.36]			68.93	[2.89]	[0.27]			55.03
GMM_2	4.12	0.47	25.50	1.28		4.31	0.40	−13.52	1.59	
	[2.08]	[0.24]			80.92	[2.35]	[0.22]			55.59
FMB	5.80	0.66	88.05	1.15		4.70	0.43	83.98	1.58	
	[2.36]	[0.27]			80.06	[2.05]	[0.19]			48.21
	[2.38]	[0.27]			81.15	[2.05]	[0.19]			49.12
$Mean$	4.53					4.11				

Panel B: Factor Betas and Pricing Errors

	All Countries					G10 Countries				
Portfolio	α_0^j	β_{IMX}^j	R^2	$\chi^2(\alpha)$	$p-val$	α_0^j	β_{IMX}^j	R^2	$\chi^2(\alpha)$	$p-val$
1	1.58	−0.36	13.45			2.03	−0.49	23.46		
	[1.70]	[0.08]				[1.80]	[0.08]			
2	0.85	0.11	0.78			1.03	0.06	0.26		
	[2.26]	[0.11]				[2.45]	[0.12]			
3	0.98	0.08	0.88			0.95	0.21	8.34		
	[1.69]	[0.08]				[1.51]	[0.08]			
4	0.91	0.15	3.02			2.03	0.51	25.60		
	[1.57]	[0.08]				[1.80]	[0.08]			
5	1.58	0.64	32.26							
	[1.70]	[0.08]								
				1.55	90.70				2.17	70.53

model. We use quarterly data to be consistent with the table in the main data, but extend the analysis to the full 01/1988 to 04/2013 sample when considering asset prices. Regressions with monthly data (unreported) yield similar results.

Table IAVIII
Asset Pricing Tests: Portfolios Sorted by the Forward Discount

This table presents asset pricing tests for various portfolios sorted on forward discounts. The panel on the left reports results for all countries in our sample. The panel on the right reports results for the G10 developed countries with most widely-traded currencies. Panel A reports results from GMM and Fama and MacBeth (1973) asset pricing tests. Market prices of risk λ, the adjusted R^2, the square root of mean-squared errors $RMSE$, and the p-values of χ^2 tests on pricing errors are reported in percentage points. b denotes SDF loadings on the IMX strategy return. All excess returns are multiplied by 12 (annualized). Shanken (1992)-corrected standard errors are reported in parentheses. We do not include a constant in the second step of the Fama-MacBeth procedure. Panel B reports OLS estimates of the factor betas and alphas (pricing errors) for each of the portfolios. R^2s and p-values are reported in percentage points. The standard errors in brackets are Newey and West (1987) standard errors computed with the optimal number of lags according to Andrews (1991). The χ^2 test statistic $\alpha' V_{\alpha}^{-1}\alpha$ tests the null that all intercepts are jointly zero. This statistic is constructed from the Newey and West (1987) variance-covariance matrix with one lag. Data are monthly, from Barclays and Reuters in Datastream. The sample period is 2/1988 to 4/2013. The alphas are annualized and in percentage points.

Panel A: Risk Prices

	All Countries					G10 Countries				
	λ_{IMX}	b_{IMX}	R^2	$RMSE$	χ^2	λ_{IMX}	b_{IMX}	R^2	$RMSE$	χ^2
GMM_1	9.30	1.05	80.97	0.79		7.84	0.72	56.64	1.67	
	[6.56]	[0.74]			83.72	[4.06]	[0.38]			21.54
GMM_2	8.74	0.99	80.39	0.80		6.20	0.57	52.09	1.75	
	[3.83]	[0.43]			84.09	[3.20]	[0.30]			24.03
FMB	9.30	1.05	87.22	0.79		7.84	0.72	75.48	1.67	
	[4.24]	[0.48]			69.48	[2.56]	[0.24]			11.30
	[4.41]	[0.50]			73.10	[2.60]	[0.24]			12.99
$Mean$	4.53					4.11				

Panel B: Factor Betas and Pricing Errors

	All Countries					G10 Countries				
Portfolio	α_0^j	β_{IMX}^j	R^2	$\chi^2(\alpha)$	$p-val$	α_0^j	β_{IMX}^j	R^2	$\chi^2(\alpha)$	$p-val$
1	−0.18	−0.19	3.72			0.54	−0.43	19.16		
	[1.69]	[0.08]				[1.83]	0.09			
2	0.10	−0.02	0.06			−0.63	0.11	1.36		
	[1.75]	[0.08]				[1.86]	[0.08]			
3	2.34	0.17	2.46			2.69	0.22	5.35		
	[2.02]	[0.09]				[1.93]	0.09			
4	1.42	0.25	6.78			3.04	0.44	16.66		
	[1.90]	[0.10]				[2.07]	[0.09]			
5	1.57	0.42	12.84							
	[2.17]	[0.11]								
				3.99	55.15				7.02	13.48

Table IAIX
IMX Returns, Productivity, Trade Costs, and Commodity Prices

This table presents regressions of various commodity indices on the IMX strategy. In addition, the first column shows regressions of quarterly returns to the IMX strategy on changes in an aggregate measure of the relative labor productivity of three G10 producer countries (Germany, Japan, and Sweden) to three G10 commodity countries (Australia, Canada, and New Zealand). Relative productivity is constructed as the GDP-weighted average of the log growth rates of labor productivity in the producer countries less the GDP weighted average of the log growth rates of productivity in the commodity countries. IMX is the return to the high-minus-low strategy constructed by sorting the full sample of IMF Advanced Economies into portfolios based on their import ratios. For more details see the main text. Monthly returns are aggregated up to the quarterly level. The remaining columns show regressions of trade costs and commodity prices on returns to the IMX strategy. The innovations in the BDI, CRB commodity indices, and crude oil prices are calculated as the quarterly log change in the index or price level. The crude oil price is the West Texas Index. Quarterly labor productivity and GDP data are from the OECD. Published productivity values are assumed to correspond to trade costs and commodity prices at the beginning of the quarter. The data are from 1991 to 2013 in the productivity regression, and 1988 to 2013 for all other regressions. Newey and West (1987) standard errors with one lag are shown in parentheses. ** and * indicate statistical significance at the 1% and 5% level, respectively.

			Commodity Research Bureau Indices					
	IMX	BDI	All	Raw Industrials	Industrial Metals	Food	Livestock	Crude Oil
Relative Productivity	1.71							
	(1.07)							
IMX		4.23*	0.62**	0.66**	1.21**	0.57**	0.63	1.67*
		(1.98)	(0.18)	(0.21)	(0.38)	(0.18)	(0.34)	(0.75)
Constant	0.01*	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Observations	89	100	100	100	100	100	100	100
R^2	0.09	0.11	0.27	0.27	0.27	0.16	0.11	0.15

Table IAX
Predicting IMX with BDI and Commodity Prices

This table reports predictive regressions of IMX on recent past growth in the Baltic Dry Index and the CRB's index of all commodity prices. Data are monthly from 01/1988 to 04/2013. Newey and West (1987) standard errors with four lags are shown in parentheses. ** and * indicate statistical significance at the 1% and 5% level, respectively.

Predictor		IMX	IMX
Lag 3-Month Change in log BDI	$\Delta BDI_{t-4,t-1}$	0.015*	
		(0.006)	
Lag 3-Month Change in log CRB Index	$\Delta CRB_{t-4,t-1}$		0.066*
			(0.028)
	Observations	304	304
	R^2	0.042	0.024

I. Predicting IMX with the BDI and Commodity Prices

In this section we report predictive regressions in the spirit of Bakshi and Panayotov (2013) and Bakshi, Panayotov, and Skoulakis (2010). We regress monthly returns to the IMX strategy on the lagged 3-month growth of both the BDI and the Commodity Research Bureau's all commodity index of traded commodity prices. Table IAX reports the results. We find that both variables have statistically and economically significant predictive power, consistent with the mechanisms of the model discussed in Section I of the main text.

J. Import Ratio and Currency Trading Strategies

The import composition of a country is highly persistent, so trading strategies created by sorting on these ratios are essentially unconditional strategies. As originally emphasized by Lustig, Roussanov, and Verdelhan (2011), a substantial portion of the returns on carry-trade strategies appear to be due to these unconditional differences in country risk. Lustig, Roussanov, and Verdelhan (2014) show that these cross-sectional strategies also appear to be largely unrelated to the profitable "Dollar Carry Trade Strategy," which goes long (short) all foreign currencies at times when the interest rate of the U.S. dollar is relatively low (high). These different strategies are formalized in a regression framework in Hassan and Mano (2014), who decompose currency risk premia associated with the failure of uncovered interest rate parity into three separate strategies, which they term the Dynamic, Static, and Dollar Strategies. Here we show that our import ratio mechanism is a likely explanation for the cross-sectional carry strategies, while having little or no explanatory power for the conditional returns of the dollar carry strategy.

Specifically, we compare strategies constructed using our import ratio to the strategies described in these papers. We focus on the post-1995 period to examine unconditional versus conditional strategies, and for the strategies of Hassan and Mano we use the G10 currencies to deliver the balanced panel necessary for the strategies of Hassan and Mano (2014). Table IAXI reports the results. In Panel A, we construct three strategies using discount rates following the work of Lustig, Roussanov, and Verdelhan (2011) for a sample based on the IMF list of Advanced Economies. In Panel B, we repeat this analysis for the G10 sample. The first strategy (HML) is based on the standard carry sort using five portfolios for the IMF Advanced Economies and four for the G10 currencies. Here we follow Lustig, Roussanov, and Verdelhan (2011) and sort currencies by the forward discount monthly, rather than annually as we did above. The HML is constructed by going long the last portfolio and short the first. The second strategy is based on an unconditional sort ($UHML$), which is constructed similarly as a long-short position by forming portfolios of countries based on their average forward discounts prior to 1995. The third strategy is the dollar carry ($DollarCarry$), which goes long an equal-weighted basket of all foreign currencies when the average forward discount is positive, and short when it is negative. As the first three columns in both panels show, all strategies have significant positive returns, with the unconditional sort explaining roughly 75% of the standard carry trade.

We confront these strategies with that based on our import ratio measure (IMX), which also earns significant positive returns, as is shown in column (4). In columns (5) to (7), we regress the returns on the carry strategies on the IMX returns. As the regressions show, the IMX strategy has high explanatory power for both cross-sectional carry strategies, and in particular completely explains the positive returns to the unconditional forward discount sort (the conditional sort has a fairly large but very marginally statistically significant alpha with respect to the IMX in the larger sample, but not the G10 sample). The betas on IMX are very high for both strategies: 0.8 for HML and essentially one for $UHML$. In contrast, the IMX has little explanatory power for the $DollarCarry$ strategy, suggesting a distinct mechanism for these returns than the one documented here.

Panel C repeats the analysis using the regression-based strategies of Hassan and Mano (2014). These strategies decompose violations of UIP into distinct components by constructing weighted portfolios using forward discounts. The first two strategies correspond to the cross-sectional carry trade, which is decomposed into a purely conditional carry trade (Dynamic) and uses rebalanced monthly weights calculated as deviations of countries' forward discounts from their pre-sample average, and purely unconditional carry trade (Static), which weights currencies using their pre-sample average forward discounts. The final strategy corresponds to the dollar carry strategy, which weights all foreign countries equally using the current average forward discount across all countries. We also construct an import ratio strategy following their methodology, using the import ratio as the weighting variable (we do not distinguish between the dynamic and the static components since the import ratio is highly persistent). As the table shows, the Static and Dollar strategies earn positive returns, as does the Import Ratio carry strategy. The Import Ratio strategy again completely explains the positive returns to the Static carry while providing no explanatory power for the Dollar carry strategy.

Table IAXI
Comparison with Other Currency Trading Strategies

This table presents returns and regressions of dollar-denominated currency strategies from 01/1995 to 04/2013 using the set of IMF Advanced Economies as well as the nine G10 currencies with the German Deutschmark substituted for the Euro prior to its adoption in 1999. Columns (1) to (4) show average annualized returns to various currency strategies constructed using forward discounts and import ratios. Columns (5) to (7) show regressions of returns to forward discount strategies on returns to the import ratio strategy from column (4). Panel A shows returns to strategies based on portfolio sorts following the work of Lustig, Roussanov, and Verdelhan (2011), using the IMF Advanced Economies. Panel B repeats the analysis of panel A using the G10 currencies. HML is constructed as a high-minus-low portfolio strategy constructed by sorting on the previous month's forward discount using five (four) portfolios for Panel A (Panel B). $UHML$ is constructed in an analogous manner by sorting on the average forward discount prior to 1995. $DollarCarry$ is the return to a trading strategy that goes long (short) an equal-weighted basket of all currencies when the average forward discount is positive (negative). IMX is a strategy constructed in the same manner as HML, but using the import ratio in calendar year $y-2$ as the sorting variable for the monthly returns in calendar year y. Panel C shows returns to strategies constructed following the regression-based decomposition of Hassan and Mano (2014). The Dynamic, Static, and Dollar strategies are described in detail in their paper. The Dollar strategy is constructed assuming the unconditional average forward discount is zero. The Import Ratio carry strategy is constructed in a manner analogous to the sum of the Dynamic and Static strategies, but with the import ratio as the weighting variable. **, *, and + indicate statistical significance at the 1%, 5%, and the 10% level, respectively.

Panel A: Comparison to Strategies of Lustig, Roussanov, and Verdelhan (2011), (2014): IMF Advanced Economies

	Average Returns					Explanatory Regressions		
	(1)	(2)	(3)	(4)		(5)	(6)	(7)
	HML	UHML	Dollar Carry	IMX		HML	UHML	Dollar Carry
Avg. Ret.	7.409**	6.168+	3.284+	5.454*	α	3.033+	0.561	2.515
	(2.306)	(3.404)	(1.771)	(2.091)		(1.609)	(2.686)	(1.778)
					β_{IMX}	0.802**	1.028**	0.141**
						(0.051)	(0.085)	(0.057)
Observations	220	220	220	220		220	220	220
					R^2	0.530	0.399	0.028

Panel B: Comparison to Strategies of Lustig, Roussanov, and Verdelhan (2011), (2014): G10 Countries

	Average Returns					Explanatory Regressions		
	(1)	(2)	(3)	(4)		(5)	(6)	(7)
	HML	UHML	Dollar Carry	IMX		HML	UHML	Dollar Carry
Avg. Ret.	6.460**	4.694*	5.809**	5.159*	α	1.851	-0.009	5.251**
	(2.429)	(2.237)	(1.858)	(2.300)		(1.313)	(0.788)	(1.866)
					β_{IMX}	0.894**	0.912**	0.108*
						(0.038)	(0.023)	(0.054)
Observations	220	220	220	220		220	220	220
					R^2	0.716	0.879	0.018

Panel C: Comparison to Strategies of Hassan and Mano (2014): G10 Countries

	Average Returns					Explanatory Regressions		
	(1)	(2)	(3)	(4)		(5)	(6)	(7)
	Static Trade	Dynamic Trade	Dollar Trade	Import Ratio Carry		Static Trade	Dynamic Trade	Dollar Trade
Avg. Ret.	1.178*	0.070	1.881**	1.992*	α	-0.073	0.258	1.769*
	(0.562)	(0.273)	(0.681)	(0.771)		(0.290)	(0.268)	(0.692)
					$\beta_{ImportRatio}$	0.628**	-0.094**	0.056
						(0.025)	(0.023)	(0.060)
Observations	220	220	220	220		220	220	220
					R^2	0.743	0.071	0.004

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