Research Agenda: Exchange Rate Puzzles and Policies*

Oleg Itskhoki

itskhoki@econ.ucla.edu

December 15, 2022

1 Introduction

Equilibrium exchange rate dynamics is a foundational topic in international macroeconomics (Dornbusch 1976, Obstfeld and Rogoff 1995). Indeed, every macroeconomic model with more than one country features exchange rates as endogenous equilibrium variables. At the same time, exchange rates present some of the most pervasive and challenging puzzles for macroeconomic models. Virtually every statistical moment of exchange rates and their comovement with other macroeconomic variables results in a long-standing puzzle in the international macroeconomic literature (Obstfeld and Rogoff 2001). Some examples of such puzzles include the tight comovement of real and nominal exchange rates (the PPP puzzle; Rogoff 1996), the weak negative correlation between real depreciations and relative consumption growth (the Backus and Smith 1993 puzzle), systematic deviations from uncovered interest rate parity (the UIP and forward premium puzzles; Fama 1984), the excessive exchange rate volatility relative to other macroeconomic aggregates and the general lack of robust comovement between the two (the Meese and Rogoff 1983 disconnect). This collection of exchange rate facts can be summarized under the umbrella of the broader exchange rate disconnect puzzle.

While the exchange rate disconnect is a well-established property of major currencies under floating exchange rate regimes, an additional challenge for the models arises from the experience of the countries shifting from an exchange rate peg to a floating regime — the Mussa puzzle. Specifically, Mussa (1986) famously observed that the end of the Bretton Woods System of fixed nominal exchange rates in 1973 led to a dramatic change in the behavior of the real exchange rate without any accompanying systematic change in the behavior of other

*Prepared for the Economic Dynamics Newsletter. Based on the recent work with Dmitry Mukhin (LSE).

macroeconomic variables (Baxter and Stockman 1989). On the one hand, this experience provides stark evidence in favor of monetary non-neutrality from the point of view of the real exchange rate. On the other hand, it can be interpreted as an extreme version of neutrality from the perspective of macroeconomic allocations which simultaneously poses a challenge for all business cycle models.

The disconnect and the Mussa puzzles provide jointly a stylized summary of the properties of exchange rates under alternative monetary policy regimes and cast doubt over conventional international macroeconomic models. To make matters worse, exchange rates play a central role in the design of international macroeconomic policies. For example, how relevant are the well-known arguments in favor of floating exchange rate regimes (Friedman 1953), the optimal currency areas (Mundell 1961), or the trilemma constraints for open-economy policies (Mundell 1963, Fleming 1962) if the underlying models cannot explain the salient properties of equilibrium exchange rates? More generally, what is the optimal exchange rate policy and the tradeoffs faced by the open-economy policies when we account for these puzzles?

The goal of this research agenda is twofold. First, it aims to offer a unifying theory of exchange rates that can simultaneously account for all the empirical facts introduced above without compromising on the model's ability to fit the business-cycle comovement of the other macroeconomic variables. Second, this agenda seeks to re-evaluate conventional propositions about open economy policies and policy regimes using this framework as well as characterize the properties and implementation of optimal exchange rate policies.

2 Purchasing Power Parity

Much of the literature on exchange rates adopts purchasing power parity (PPP) as the foundational concept. While the strong form of the PPP hypothesis requires that price levels equalize across countries, a more relevant weak form of PPP only mandates that the the real exchange rate (RER) — equal to PPP deviations — be mean-stationary. Stationarity of RER is a deeply held believe in the economics literature, adopted both as an econometric benchmark in empirical analyses and as an exogenous assumption in theoretical papers, even though statistical evidence for RER stationarity is weak if present (Rogoff 1996, Burstein and Gopinath 2012). This stationarity assumption is supported by the conventional view that exchange rates are driven by monetary shocks which are neutral in the long run, and result in a conintegration relationship between nominal devaluations (loss of purchasing power in terms of foreign currency) and relative inflation (loss of purchasing power in terms of goods). However, in the short-run, monetary shock result in PPP deviations and RER dynamics when prices are slow to adjust. In fact, for this reason, the behavior of RER is often viewed as evidence in favor of nominal non-neutrality and price stickiness.

This view of PPP deviations was also reinforced by the influential work of Engel (1999) who documented that the bulk of RER volatility comes from the tradable component of price levels as opposed to relative prices of non-tradables, thus falsifying the alternative non-tradable view of RER. This inspired a literature which searched for sources for the deviations from the law of one price in tradeables focusing on nominal price stickiness and variables markups (pricing to market) as the main drivers of PPP deviations. In other words, this literature delved deeper into exploring the transmission mechanisms of monetary shocks rather than challenging the more fundamental assumption of whether monetary shocks are in fact the key drivers of exchange rates.[1]

This approach to the exchange rate produced the famed PPP puzzle: the fact that RER does not mean revert fast enough to match realistic estimates of nominal rigidities (Rogoff 1996, Chari, Kehoe, and McGrattan 2002). This PPP property is additionally burdened by the equally puzzling cross-sectional patterns of sectoral RERs (Kehoe and Midrigan 2008) and time-series patterns of the reset-price RER (Blanco and Cravino 2020). Furthermore, while the sticky price and the variable-markup mechanisms for the law of one price violations are important for understanding the dynamics of micro-level prices and the terms of trade in the data, these mechanisms cannot explain the behavior of the aggregate RER (Itskhoki 2021).[2]

In Itskhoki and Mukhin (2021a), we argue that the focus on nominal rigidities is misplaced. Instead, we suggest an entirely different perspective, which deemphasizes nominal rigidities, and instead shifts focus to the nature of the shock process. The behavior of RER is evidence neither in favor *nor* against sticky prices, but instead suggests that monetary shocks *cannot* be the key source of exchange rate fluctuations. We show that shocks in the financial market can drive both nominal and real exchange rates in concert, in line with the patterns of PPP deviations in the data. In fact, such a view of PPP deviation only requires that these shocks produce volatile and persistent exchange rate fluctuations without compromising the ability of central banks to stabilize inflation (see also Eichenbaum, Johannsen, and Rebelo 2021). This is, indeed, the case for financial shocks under an empirically realistic degree of home bias in consumption even for smaller more open economies.

[1] See Alvarez, Atkeson, and Kehoe (2007) who also challenge the transmission mechanism of monetary policy from the point of view of the financial market but not the nature of exchange rate shocks.

[2] See Atkeson and Burstein (2008) and Amiti, Itskhoki, and Konings (2019) for pricing to market and variable markups and Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller (2020), Mukhin (2022) and Amiti, Itskhoki, and Konings (2022) for dominant currency price stickiness, surveyed in Gopinath and Itskhoki (2021).

3 Equilibrium Exchange Rate Disconnect

Consistent with observed patterns of PPP deviations (which track nominal exchange rates), inflation-stabilizing monetary policy ties together nominal and real exchange rates. However, this means that PPP moments — which are partial equilibrium in nature — do not help us make further progress in understanding the equilibrium properties of the exchange rate, which requires a full general equilibrium analysis. The equilibrium exchange rate, real and thus nominal, is shaped by the interplay of three forces: (i) a static goods market clearing condition with international expenditure switching; (ii) a dynamic forward-looking financial market equilibrium condition characterizing international risk sharing; and (iii) the intertemporal budget constraint of the country. Earlier work on exchange rates brought a spotlight to both the financial market equilibrium (e.g. Engel and West 2005) and the country budget constraint (e.g. Gourinchas and Rey 2007), but the role of the goods market clearing condition has been somewhat overshadowed.

In Itskhoki and Mukhin (2021a), we emphasize a simple mapping between these three equilibrium forces and the dynamic properties of the exchange rate. Financial market equilibrium (a martingale-like condition) shapes expected exchange rate changes. The intertemporal budget constraint provides an integral condition on the level (or the long-run mean) of the exchange rate, and thus characterizes its unexpected jumps in response to shocks. Crucially, it is the sustainability (transversality) condition on the net foreign asset position of a country that shapes the long-run exchange rate, not purchasing power parity. In general, RER may follow a stationary or an integrated process with partial mean reversion. In both cases, this process is consistent with empirical evidence on persistent PPP deviations with very long measured half lives.

Finally, the comovement between the exchange rate and macroeconomic variables is shaped by the interplay between the goods market clearing and the financial market equilibrium conditions which allows us to infer the composition of shocks driving exchange rate dynamics. In the limiting case of complete asset markets, the risk sharing condition fully assumes this role, resulting in the famed Backus and Smith (1993) puzzle (see also Kollmann 1995). Indeed, perfect risk sharing (under CRRA utility) implies perfect comovement between relative consumption and real devaluations which equalizes the cost of delivering marginal utility across countries. However, this correlation is typically negative and always small in the data.

Complete markets is, arguably, an unrealistic benchmark. Do incomplete markets help us explain this puzzle? The real challenge for this literature proved to be the fact that the nearly perfect positive correlation between RER and relative consumption remains a robust feature of a variety of international macro models even when international asset markets are incomplete. The set of such models includes both international real business cycle (IRBC) models with productivity shocks and New-Keynesian open economy (NKOE) models with sticky prices with monetary and productivity shocks. We show that the key to this puzzle is contained in the international goods market clearing condition. More specifically, we argue that the empirical Backus-Smith correlation is the property shaped by the goods market equilibrium — and, in particular, by expenditure switching, not international risk sharing.

First, consider what happens with conventional macroeconomic shocks which expand the output available for consumption (production net of investment). Greater domestic output — whether driven by high productivity in IRBC models or by reduced markups in response to monetary expansion in NKOE models — results in greater relative domestic consumption due to home bias. Such shocks also ensure lower relative domestic prices — whether due to lower marginal costs in IRBC models or due to lower markups in NKOE models — bringing about a real depreciation. Thus, a strong correlation between relative consumption and real devaluations is a robust property of conventional business cycle models irrespective of asset market completeness.[3]

Suppose, instead, that shocks come from the financial market. For concreteness, consider a savings shock that compels households to delay consumption without any change to the production possibility frontier.[4] For the goods market to clear, a decline in home aggregate consumption must be accommodated with a real depreciation to shift global expenditure towards domestically produced goods which otherwise would be in excess supply. Furthermore, the stronger the home bias in consumption, the larger is the needed devaluation. Thus, we immediately get both a negative correlation between consumption as well as excessive exchange rate volatility as observed in the data. We further show that smaller less home-biased economies end up in equilibrium with somewhat more volatile macro quantities and somewhat less volatile exchange rates, again consistent with the data.

Importantly, the logic above extends directly to other, more practical, financial shocks such as an increased demand for dollars under segmented financial markets and inelastic supply of currencies (Gabaix and Maggiori 2015, Jiang, Krishnamurthy, and Lustig 2021). Such shocks, broadly captured by uncovered interest rate parity (UIP) deviations (Devereux and Engel 2002), result in volatile and persistent exchange rate devaluations and reduced domestic consumption due to the expenditure switching force in the goods market. However, expenditure switching is a weak force when home bias is strong. Thus, consistent with the exchange rate disconnect and

[3]Breaking this correlation requires a violation of the Marshall-Lerner condition (Itskhoki 2021), or that the local investment response systematically overwhelms increased production (Corsetti, Dedola, and Leduc 2008), or that productivity shocks only bear fruit far into the future (see Colacito and Croce 2013, and the discussion of news shocks below).

[4]Taken literally, such a savings shock can be introduced via a temporal utility shock as in Stockman and Tesar (1995), which however triggers strong movements in interest rates and asset prices, violating the other exchange rate disconnect properties (Itskhoki and Mukhin 2022c).

its weak predictability (Meese and Rogoff 1983), the response of macro variables to financial shocks is mild and dominated by fundamental macroeconomic shocks.

Finally, we circle back to the mild negative Backus-Smith correlation in the data. This offers an ideal identifying moment for the composition of shocks that drive the equilibrium exchange rate.[5] Conventional macroeconomic shocks, while successful in explaining the business cycle comovement, result in a counterfactual positive Backus-Smith correlation. By contrast, financial shocks deliver a correlation with the correct negative sign and, importantly, generate a large gap in the volatility of exchange rates relative to macroeconomic aggregates. Thus, when combined together, the two sets of shocks allow the model to reproduce the exchange rate disconnect behavior together with the standard international business cycle comovement of the macro variables (as in e.g. Backus, Kehoe, and Kydland 1992). In order to jointly reproduce the Backus-Smith correlation and the excess volatility of the exchange rate, the model requires that exchange rates are largely driven by financial shocks, while macro variables are still mostly driven by fundamental macroencomic shocks, consistent with the goods market home bias. Put differently, real devaluations must be mostly triggered by relative demand shocks for foreign-currency assets rather than supply shocks to domestically-produced goods.

4 Monetary Regimes and the Mussa Puzzle

Explaining the equilibrium exchange rate disconnect, rather surprisingly, imposes little structure on the model. The disconnect mechanism relies on two essential ingredients — home bias in the product market and an imperfect financial market featuring equilibrium UIP violations. However, it is not essential to specify which financial shocks drive UIP deviations nor the exact structure of the financial market. In fact, models of rare disasters, long-run risk, and news shocks can be consistent with certain properties of the exchange rate disconnect even under complete markets (Farhi and Gabaix 2016, Colacito and Croce 2013, Chahrour, Cormun, De Leo, Guerron-Quintana, and Valchev 2021). At the other end of the admissible spectrum are models of segmented financial markets with noise traders and limits to arbitrage (Jeanne and Rose 2002, Gabaix and Maggiori 2015), with a variety of models in between (e.g., expectational errors and heterogeneous beliefs, portfolio adjustment costs, convenience yields, etc). This indeterminacy sets up a roadblock en route from a positive model of exchange rates to a normative analysis of the optimal exchange rate policies. The Mussa puzzle represents an important challenge for the models and its resolution provides a clear pathway towards the

[5] This logic can be conveniently illustrated as the intersection of the goods market clearing and the equilibrium risk sharing curves in the (relative) consumption–RER space. The productivity and monetary shocks shift the former curve, while financial shocks shift the latter curve. See Figure 1 in the Disconnect teaching note on my website.

policy analysis, as we argue in Itskhoki and Mukhin (2021b, 2022a).

Mussa (1986) famously observed that the end of the Bretton Woods System in 1973 and the change from pegged to floating exchange rates naturally led to an increase in the volatility of nominal exchange rates (by an order of magnitude), but also instantaneously increased the volatility of *real* exchange rates by nearly the same factor. This fact is commonly viewed by economists as a central piece of evidence in favor of monetary non-neutrality because the change in monetary regime caused a dramatic change in the equilibrium behavior of a real variable — the real exchange rate (Nakamura and Steinsson 2018). However, this narrative misses the fact that there was no simultaneous change in the properties of other macro variables — either nominal like inflation, or real like consumption and output (Baxter and Stockman 1989, Flood and Rose 1995). One could interpret this as an extreme form of neutrality. That is, a major shift in the monetary regime increases the volatility of the nominal exchange rate by an order of magnitude but does not affect the equilibrium properties of any other macro variable apart from the real exchange rate. In fact, this is a considerably more puzzling part of the larger set of "Mussa facts".

The conventional wisdom among both academic researchers and policymakers is that the Mussa puzzle points to the importance of nominal rigidities, particularly at the border, which mute the transmission of increased exchange rate volatility into inflation, consumption and output (Monacelli 2004). However, this partial equilibrium interpretation misses the second — general equilibrium — part of the picture. Specifically, a change in equilibrium exchange rate volatility requires a change in monetary policy which, in conventional business cycle models, must be accompanied by changing properties of either inflation (IRBC) or output (NKOE), or both. Furthermore, monetary policy has a direct effect on inflation, consumption, investment, and GDP — even in the closed-economy limit with zero aggregate exchange rate pass-through. Therefore, this argument does not rely on trade openness or the nature of price stickiness at the border, and thus applies even for relatively closed economies, such as the US, importing goods in domestic currency.

Put differently, what is most puzzling is not the missing inflation and output volatility under the float (which can be muted with low pass-through at the border), but rather the missing macroeconomic volatility under the peg. Where does all the excess exchange rate volatility go when it has to be offset by monetary policy under the peg? This is the core of the Mussa puzzle. To address it, in Itskhoki and Mukhin (2021b), we propose an alternative framework where monetary non-neutrality arises regardless of nominal rigidities due to financial market segmentation with international capital flows intermediated by risk-averse arbitrageurs. The model features liquidity demand shocks in international asset (currency) markets resulting in equilibrium UIP deviations which are essential in explaining the exchange rate disconnect from macroeconomic fundamentals under a floating regime. Interestingly, while exchange rate disconnect can be explained with exogenous UIP (or even CIP) shocks, such shocks are inconsistent with the Mussa puzzle because it requires UIP deviations that are *endogenous* to the monetary policy regime (*cf.* Kollmann 2005).

A change in the exchange rate regime and the associated change in the nominal exchange rate volatility affect the quantity of risk faced by intermediaries when participating in international financial transactions, in particular in currency carry trades. Greater nominal exchange rate volatility discourages intermediation and results in larger risk sharing wedges across countries under the floating regime. In contrast, the lower nominal exchange rate volatility under the peg encourages intermediation, shielding the real exchange rate from financial shocks. As a result, a change in the monetary regime has real consequences via the financial market, even when prices are fully flexible, and thus affects the volatility of both nominal and real exchange rates simultaneously. This mechanism is consistent with larger deviations from the uncovered interest rate parity (UIP) and more distorted international risk sharing, as measured by the Backus-Smith correlation, after the breakdown of Bretton Woods.

Importantly, a credible commitment to a peg encourages intermediaries to absorb most of the shocks in financial markets confronting the monetary authority with little need to compromise between inflation and exchange rate stabilization. As a result, the model is consistent with a dramatic change in exchange rate volatility unaccompanied by any comparable change in macroeconomic volatility, whether nominal or real. Instead, macroeconomic aggregates are primarily shaped by fundamental macroeconomic forces (such as productivity and aggregate demand shocks) and, in turn, are largely insensitive to volatility in the international financial market and the resulting exchange rate volatility. This characterization provides an 'order-of-magnitude' intuition for the observed empirical patterns, where dramatic discontinuity in the behavior of exchange rates was not accompanied by any comparable change in macroeconomic volatility. However, this does not mean that fixed exchange rates come at no cost in terms of allocative efficiency, a theme that we discuss next.

5 Optimal Exchange Rate Policy

This new interpretation of the Mussa puzzle fits well with the growing evidence supporting the transmission of monetary shocks via financial markets (e.g. Rey 2013, Kalemli-Özcan 2019, Gourinchas 2022) and has several important policy implications which we explore in Itskhoki and Mukhin (2022a). In particular, it points to a fundamental trade-off faced by monetary authorities in open economies. Namely, a floating exchange rate regime improves allocations in the product market by facilitating international expenditure shifting in response to macroeconomic shocks (Friedman 1953). Yet, it results in excessive exchange rate volatility in response to financial shocks, which limits the extent of international risk sharing. This endogenous financial amplification of exchange rate volatility is what makes the model both consistent with Mussa facts and different in its policy implications from the trilemma-style models (the vast literature following Mundell 1963, Fleming 1962) and models with exogenous financial shocks (e.g. Basu, Boz, Gopinath, Roch, and Unsal 2020) alike.

We show that, in general, a combination of two policy instruments is required to achieve the efficient allocation: conventional interest rate policy to stabilize the inflation and output gap and foreign exchange (FX) interventions to eliminate frictional UIP deviations (rather than target a particular level of the exchange rate). The latter policy tool is highly effective under segmented financial markets and limited intermediation, which simultaneously give rise to endogenous UIP violations and relax the trilemma constraint on policy. Nonetheless, FX interventions are subject to several additional restrictions. In particular, the inability to have negative foreign reserves, the risks associated with expanding the central bank's balance sheet, and a limited ability to disentangle financial and fundamental shocks make the first best policy generally infeasible.

When FX interventions are constrained, and the central bank is limited to monetary policy alone, there exists a special case when monetary policy can simultaneously achieve the optimal outcome in the product market and undistorted internationally risk sharing in the financial market. We refer to it as an open-economy counterpart to the celebrated 'divine coincidence' in the closed economy. In particular, this special case obtains when the real exchange rate supporting the first-best allocation in the product market is constant. When this holds, the monetary authority should fully stabilize the nominal exchange rate using exchange rate targeting. In this case, fixed exchange rate simultaneously stabilized domestic inflation, eliminates the output gap, and guarantees efficient international risk sharing in the absence of currency risk. This also suggests a new perspective on the optimal currency area argument (Mundell 1961), emphasizing financial market benefits in addition to goods market losses from the fixed exchange rate regime.

More generally, optimal policy faces a trade-off and must deviate from exclusive inflation and output gap targeting in order to partially stabilize the nominal exchange rate by eliminating excessive exchange rate volatility. The optimal policy in this case resembles a crawling peg. That is, in times of financial stability and small UIP deviations the focus of the policy is exclusively inward looking (as in the closed economy) but, in moments of financial distress and large capital (out)flows, the policy adjusts to curb excessive exchange rate movements. This is arguably the reason why empirically we observe considerable "fear of floating" and vast proliferation of various partially floating and partially pegged exchange rate regimes (Ilzetzki, Reinhart, and Rogoff 2019). Finally, the credibility of monetary policy plays a central role because financial market expectations are key determinants of risk premia. As such, it is not possible to improve international risk sharing without reputation and commitment to a policy regime.[6]

6 Open Questions and Directions for Future Research

While settling some questions, this research agenda leaves many questions open and gives rise to a large number of additional challenges to address. An obvious open question is about the nature of financial shocks and the structure of the financial market. For a variety of recent approaches to this question see e.g. Camanho, Hau, and Rey (2018), Gourinchas, Ray, and Vayanos (2019), Koijen and Yogo (2020), Bianchi, Bigio, and Engel (2021) and Itskhoki and Mukhin (2022c). An additional question is whether fundamental macroeconomic shocks trigger reduced-form financial shocks, as for example could be with news shocks about future productivity, default, monetary policy or quantitative easing.

An issue of central importance for the implementation of optimal exchange rate policies lies in the measurement of fundamental and financial shocks, and, in particular, their effects on UIP and CIP deviations (see e.g. Du, Tepper, and Verdelhan 2018, Kalemli-Özcan and Varela 2021). The challenge here is that, unlike CIP, UIP deviations are not directly observable because we do not know financial market's expectations about future exchange rates. In this sense UIP deviations are similar to output gaps or 'natural rates' in that they need to be inferred indirectly from the data. Furthermore, a component of UIP deviations is fundamental and reflects currency risk from the point of view of a representative household (or the central bank acting on their behalf). The goal is then to measure the frictional component of UIP deviations — the target of FX interventions — which combines wedges induced by financial constraints, intermediation risk and markups.

The policy implications of this research agenda extent into such policy areas as border taxation, trade wars, currency wars and international sanctions which are receiving a lot of spotlight recently (see e.g. Barbiero, Farhi, Gopinath, and Itskhoki 2019, Auray, Devereux, and Eyquem 2021, Jeanne 2021, Hassan, Mertens, and Zhang 2022, Itskhoki and Mukhin 2022b). Furthermore, the policy implications are not limited to an open economy environment. The ability of a peg to stabilize the risk premium on the carry trade raises the question of whether

[6] Interestingly, a contemporaneous monetary tightening, while appreciating the exchange rate, may not fend off capital outflows or close UIP deviations, which depend on the expected future exchange rate volatility. In contrast, a monetary tightening today which comes at the cost of more volatile future policies, destabilizes the financial market. Curbing UIP deviations with monetary policy requires a credible commitment to reducing future exchange rate volatility.

monetary policy can and should partially stabilize the volatility of risk premia in other financial markets, including equity and long-term debt. How such policies affect the economy and whether they are desirable are important questions currently being addressed in the parallel closed economy literature (see e.g. Caballero and Simsek 2022, Kekre and Lenel 2022).

References

Alvarez, F., A. Atkeson, and P. J. Kehoe (2007): "If Exchange Rates are Random Walks, Then Almost Everything We Say About Monetary Policy is Wrong," *American Economic Review*, 97(2), 339–345.

Amiti, M., O. Itskhoki, and J. Konings (2019): "International Shocks, Variable Markups and Domestic Prices," *Review of Economic Studies*, 86, 2356–402.

——— (2022): "Dominant Currencies: How firms choose currency invoicing and why it matters," *The Quarterly Journal of Economics*, 137, 1435–93.

Atkeson, A., and A. T. Burstein (2008): "Trade Costs, Pricing-to-Market, and International Relative Prices," *American Economic Review*, 98(5), 1998–2031.

Auray, S., M. B. Devereux, and A. Eyquem (2021): "Trade Wars, Currency Wars," Center for Research in Economics and Statistics Working Papers No. 2021-15.

Backus, D. K., P. J. Kehoe, and F. E. Kydland (1992): "International Real Business Cycles," *Journal of Political Economy*, 100(4), 745–75.

Backus, D. K., and G. W. Smith (1993): "Consumption and real exchange rates in dynamic economies with non-traded goods," *Journal of International Economics*, 35(3–4), 297–316.

Barbiero, O., E. Farhi, G. Gopinath, and O. Itskhoki (2019): "The Macroeconomics of Border Taxes," *NBER Macroeconomics Annual*, 33(1), 395–457.

Basu, S. S., E. Boz, G. Gopinath, F. Roch, and F. D. Unsal (2020): "A Conceptual Model for the Integrated Policy Framework," IMF Working Papers No. 2020/121.

Baxter, M., and A. C. Stockman (1989): "Business cycles and the exchange-rate regime: Some international evidence," *Journal of Monetary Economics*, 23(3), 377–400.

Bianchi, J., S. Bigio, and C. Engel (2021): "Scrambling for Dollars: International Liquidity, Banks and Exchange Rates," https://www.ssc.wisc.edu/~cengel/.

Blanco, A., and J. Cravino (2020): "Price Rigidities and Relative PPP," *Journal of Monetary Economics*, 116, 104–116.

Burstein, A. T., and G. Gopinath (2012): "International Prices and Exchange Rates," in *Handbook of International Economics*, ed. by G. Gopinath, E. Helpman, and K. S. Rogoff, vol. IV.

Caballero, R. J., and A. Simsek (2022): "A Monetary Policy Asset Pricing Model," NBER Working Paper No. 30132.

Camanho, N., H. Hau, and H. Rey (2018): "Global Portfolio Rebalancing and Exchange Rates," NBER Working Paper No. 24320.

Chahrour, R., V. Cormun, P. De Leo, P. Guerron-Quintana, and R. Valchev (2021): "Exchange Rate

Disconnect Redux," Boston College Working Papers in Economics No. 1041.

Chari, V., P. J. Kehoe, and E. R. McGrattan (2002): "Can Sticky Price Models Generate Volatile and Persistent Exchange Rates?," *Review of Economic Studies*, 69(3), 533–63.

Colacito, R., and M. M. Croce (2013): "International Asset Pricing with Recursive Preferences," *Journal of Finance*, 68(6), 2651–2686.

Corsetti, G., L. Dedola, and S. Leduc (2008): "International Risk Sharing and the Transmission of Productivity Shocks," *Review of Economic Studies*, 75(2), 443–473.

Devereux, M. B., and C. Engel (2002): "Exchange rate pass-through, exchange rate volatility, and exchange rate disconnect," *Journal of Monetary Economics*, 49(5), 913–940.

Dornbusch, R. (1976): "Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, 84(6), 1161–76.

Du, W., A. Tepper, and A. Verdelhan (2018): "Deviations from Covered Interest Rate Parity," *The Journal of Finance*, 73(3), 915–957.

Eichenbaum, M. S., B. K. Johannsen, and S. T. Rebelo (2021): "Monetary policy and the predictability of nominal exchange rates," *The Review of Economic Studies*, forthcoming.

Engel, C. (1999): "Accounting for U.S. Real Exchange Rate Changes," *Journal of Political Economy*, 107(3), 507–38.

Engel, C., and K. D. West (2005): "Exchange Rates and Fundamentals," *Journal of Political Economy*, 113(3), 485–517.

Fama, E. F. (1984): "Forward and spot exchange rates," *Journal of Monetary Economics*, 14(3), 319–338.

Farhi, E., and X. Gabaix (2016): "Rare Disasters and Exchange Rates," *Quarterly Journal of Economics*, 131, 1–52.

Fleming, J. M. (1962): "Domestic Financial Policies under Fixed and under Floating Exchange Rates," *IMF Staff Papers*, 9(3), 369–380.

Flood, R. P., and A. K. Rose (1995): "Fixing exchange rates A virtual quest for fundamentals," *Journal of Monetary Economics*, 36(1), 3–37.

Friedman, M. (1953): "The case for flexible exchange rates," *Essays in positive economics*, 157(203), 33.

Gabaix, X., and M. Maggiori (2015): "International Liquidity and Exchange Rate Dynamics," *The Quarterly Journal of Economics*, 130(3), 1369–1420.

Gopinath, G., E. Boz, C. Casas, F. J. Díez, P.-O. Gourinchas, and M. Plagborg-Møller (2020): "Dominant currency paradigm," *American Economic Review*, 110(3), 677–719.

Gopinath, G., and O. Itskhoki (2021): "The Existence and Implications of Dominant Currencies," in *Handbook of International Economics*, ed. by G. Gopinath, E. Helpman, and K. Rogoff, vol. V. forthcoming.

Gourinchas, P.-O. (2022): "International Macroeconomics: From the Great Financial Crisis to COVID-19, and Beyond," *IMF Economic Review*, 70(1), 1–34.

Gourinchas, P.-O., W. Ray, and D. Vayanos (2019): "A preferred-habitat model of term premia and currency risk," Discussion paper, mimeo.

Gourinchas, P.-O., and H. Rey (2007): "International Financial Adjustment," *Journal of Political Econ-*

omy, 115(4), 665–703.

Hassan, T. A., T. M. Mertens, and T. Zhang (2022): "A Risk-based Theory of Exchange Rate Stabilization," *The Review of Economic Studies*, forthcoming.

Ilzetzki, E., C. M. Reinhart, and K. S. Rogoff (2019): "Exchange arrangements entering the twenty-first century: Which anchor will hold?," *The Quarterly Journal of Economics*, 134(2), 599–646.

Itskhoki, O. (2021): "The Story of the Real Exchange Rate," *Annual Review of Economics*, 13, 423–55.

Itskhoki, O., and D. Mukhin (2021a): "Exchange Rate Disconnect in General Equilibrium," *Journal of Political Economy*, 129, 2183–2232.

——— (2021b): "Mussa Puzzle Redux," NBER Working Paper No. 28950.

——— (2022a): "Optimal Exchange Rate Policy," https://itskhoki.com/papers/ERpolicy.pdf.

——— (2022b): "Sanctions and the Exchange Rate," NBER Working Paper No. 30009.

——— (2022c): "What Drives the Exchange Rate?," in preparation.

Jeanne, O. (2021): "Currency Wars, Trade Wars, and Global Demand," NBER Working Paper No. 29603.

Jeanne, O., and A. K. Rose (2002): "Noise Trading and Exchange Rate Regimes," *The Quarterly Journal of Economics*, 117(2), 537–569.

Jiang, Z., A. Krishnamurthy, and H. N. Lustig (2021): "Foreign Safe Asset Demand and the Dollar Exchange Rate," *The Journal of Finance*, 76(3), 1049–1089.

Kalemli-Özcan, S. (2019): "US monetary policy and international risk spillovers," Jackson Hole Symposium Proceedings.

Kalemli-Özcan, S., and L. Varela (2021): "Five Facts about the UIP Premium," NBER Working Paper No. 28923.

Kehoe, P. J., and V. Midrigan (2008): "Sticky Prices and Real Exchange Rates in the Cross-Section," http://www.virgiliumidrigan.com/.

Kekre, R., and M. Lenel (2022): "Asset Prices and Business Cycles with Segmented Markets," working paper.

Koijen, R. S. J., and M. Yogo (2020): "Exchange Rates and Asset Prices in a Global Demand System," NBER Working Papers No. 27342.

Kollmann, R. (1995): "Consumption, real exchange rates and the structure of international asset markets," *Journal of International Money and Finance*, 14(2), 191–211.

——— (2005): "Macroeconomic effects of nominal exchange rate regimes: new insights into the role of price dynamics," *Journal of International Money and Finance*, 24(2), 275–292.

Meese, R., and K. S. Rogoff (1983): "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?," *Journal of International Economics*, 14(1), 3–24.

Monacelli, T. (2004): "Into the Mussa puzzle: monetary policy regimes and the real exchange rate in a small open economy," *Journal of International Economics*, 62(1), 191–217.

Mukhin, D. (2022): "An Equilibrium Model of the International Price System," *American Economic Review*, 112(2), 650–88.

Mundell, R. A. (1961): "A Theory of Optimum Currency Areas," *The American Economic Review*, 51(4), 657–65.

Mundell, R. A. (1963): "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates," *The Canadian Journal of Economics and Political Science*, 29(4), 475–485.

Mussa, M. L. (1986): "Nominal exchange rate regimes and the behavior of real exchange rates: Evidence and implications," *Carnegie-Rochester Conference Series on Public Policy*, 25(1), 117–214.

Nakamura, E., and J. Steinsson (2018): "Identification in Macroeconomics," *Journal of Economic Perspectives*, 32(3), 59–86.

Obstfeld, M., and K. S. Rogoff (1995): "Exchange Rate Dynamics Redux," *Journal of Political Economy*, 103, 624–60.

——— (2001): "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?," in *NBER Macroeconomics Annual 2000*, vol. 15, pp. 339–390.

Rey, H. (2013): "Dilemma not trilemma: the global financial cycle and monetary policy independence," *Jackson Hole Symposium Proceedings.*

Rogoff, K. S. (1996): "The Purchasing Power Parity Puzzle," *Journal of Economic Literature*, 34, 647–668.

Stockman, A. C., and L. L. Tesar (1995): "Tastes and Technology in a Two-Country Model of the Business Cycle: Explaining International Comovements," *The American Economic Review*, 85(1), 168–185.