



# A transaction-cost model of chronic specie scarcity and the evolution of monetary structures in constrained colonial economies

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Received: 24 October 2024 / Accepted: 17 January 2025  
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## Abstract

A transaction-cost model of monetary choice is used to justify colonists' claims that specie money for executing within-colony trades and paying local taxes was chronically scarce in Britain's pre-nineteenth century North American colonies. This scarcity is shown to be the result of individual rational maximizing choice behavior given the constraints imposed on the colonies by their mother country. By contrast, the conventional quantity-theory-of-money, specie-flow model indicates that a chronic specie scarcity equilibrium is impossible. Implicit assumptions in the quantity-theory-of-money model are shown to not apply to these colonial economies. The transaction-cost model developed here builds on the Walrasian–Arrow–Debreu general equilibrium model by incorporating transaction costs and media-of-exchange structures into the market clearing mechanism. Specie (outside money) and non-specie-money media-of-exchange structures (inside monies), which have differing transaction costs, are added to the model. Those additions, along with import substitution and trade-control constraints, identify the plausible circumstances that yield a chronic specie scarcity outcome in a colony. Whether the individual rational maximizing monetary choices that produce chronic specie scarcity in a colony lead to sub-optimal or to optimal social welfare outcomes in that colony depends on what non-specie media-of-exchange structures emerge as the inside money in that colony.

**Keywords** Colonial economies · General equilibrium · Monetary systems · Specie scarcity · Transaction costs

**JEL Classification** D23 · E42 · N11

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## 1 Introduction

The internal economic development of pre-nineteenth century European colonies around the globe is an important topic, especially because internal economic development is a prerequisite for political independence. On several margins, European mother countries constrained the sovereignty of their colonies thereby altering their internal economic development. How colonies adapted to these constraints varied by the type of constraint imposed given the economic circumstances in each colony. One such constraint affected within-colony monetary usage.

European governments constrained what monies or media of exchange predominated within their colonies, which in turn affected the development of internal trade within their colonies and the ability of colonial administrations to collect within-colony taxes. European governments often imposed trade and monetary controls that prevented their colonies from banning the export of specie money (gold and silver coins), from imposing import tariffs that encouraged internal economic development to replace imported goods, and from developing internal monetary systems for executing within-colony trades. European governments often instituted policies designed to encourage trade surpluses with their colonies so that the mother country's producers would have a ready overseas market for their goods and so that specie money would flow to the mother county from their colonies to balance trade flows.

In the seventeenth and eighteenth centuries, specie was the universal money—the outside money. It was the money the rest of the world used to consummate transactions that crossed polity borders, and it was the money often used by Europeans to consummate domestic transactions within their respective polities.<sup>1</sup> Colonists referred to specie as *real* money.

The current, and perhaps only, model of monetary usage in pre-nineteenth century European colonies is the quantity theory of money embedded in a specie-flow arbitrage mechanism. Specie money flows to where it is scarce until values are equalized across locations. As such, specie money can never be chronically scarce. Yet, British North American colonists constantly complained that specie money for executing internal trade and paying local taxes was chronically scarce. If we take these colonists' claims seriously, we need an alternative model of monetary usage for these colonies that is consistent with this specie scarcity outcome.

While the focus here is on the British North American colonies, the general conditions and outcomes modeled below have broader applications. All economically underdeveloped and colonially constrained small polities with open economies faced similar circumstances, namely if they did not produce their own gold and silver, they

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<sup>1</sup> Specie is a commodity money typically in the form of gold and silver coins minted by a sovereign, but sometimes taken in the form of bullion or plate. Exchange rates between different specie coins are governed roughly by their commodity content. See McCusker (1978). As such, specie readily crosses borders to transact trade between polities with different specie coins. Specie was the primary, if not only, outside money in this period. Outside monies are monies that lose little value when crossing polity borders, either because they have some universal commodity value at their core or because a defended and believable fixed exchange rate exists between that money and other outside, or other polity-specific, monies.

had to import specie coins to use as internal money. As such, a large set of pre-nineteenth century colonies around the globe fall within the model developed here.

To what extent European-government constraints on colonial sovereignty affected monetary structures and the composition of monies used within a colony, and so the extent of internal trade and economic development within a colony, is difficult to measure quantitatively. Pre-nineteenth century, comprehensive quantitative evidence on the composition of the monies used to execute within-colony trade and to pay within-colony taxes is rare (for an exception see Grubb 2004). As such, a rational choice model to justify colonial complaints of specie scarcity is needed to help justify those complaints. Developing such a model is the task of this paper.

I will first articulate what motivates this debate over monetary usage in British North American colonies. Next, I will use the foundations of general equilibrium price theory to address how we should think about what money is per se in a world where many possible ways to mediate an exchange can be invented or adopted to execute local trades. I will then embed these considerations within the institutional and regulatory constraints imposed on these colonies regarding colony-created monies. Finally, I will lay out a transaction-cost model of chronic specie scarcity for these constrained colonial economies.<sup>2</sup>

Key features of this transaction-cost model are that while using specie coins are assumed to always be transaction-cost superior in all settings, colonists with specie coins cannot capture the positive externality specie coins generate transaction-cost-wise when used in subsequent trades within the local economy.<sup>3</sup> As such, colonists with specie coins are led to export them to buy imported goods rather than use them to execute local trades. They will do this when there are no local substitutes for desired imports and imports can only be purchased with specie coins. That pressure leads to adopting alternative local media-of-exchange methods that are less efficient than using specie coins to execute local trades but are nevertheless a rational maximizing choice for colonists to use when faced with the gains from exporting their specie to purchase imports rather than using that specie to buy local goods. In the colonies, chronic specie scarcity is the outcome of individual rational maximizing choices that leads to sub-optimal social welfare (economic development) outcomes. Overcoming this sub-optimal social welfare outcome requires developing better

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<sup>2</sup> Transaction costs arise from the transfer of ownership (property rights) in goods, services, and assets. Transaction costs may include the cost of parties to an exchange having to find each other and having to communicate and exchange information. The goods, services, and assets being traded must be described, inspected, weighed and measured, and bargained over. Agreements must be fixed, and title and records kept or understood. The potential costs of legal enforcement and execution-completion probabilities must also be understood. See Eatwell et al. (1987, 4: 676).

<sup>3</sup> It is assumed that the transaction costs associated with using a particular media of exchange, such as a specie coin, are uniquely associated only with the current executed exchange. The relative transaction-cost gains associated with using that media of exchange in future trades are then unique to each future trade executed and cannot be priced into prior consummated trades. This assumption comes from the notion that transaction costs of each trade are largely experiential events of the traders involved at the point of exchange. They involve a bewildering complexity unique to each trade making transaction costs difficult to quantify for future trades using that media of exchange that do not involve the original parties to the first trade. See Eatwell et al. (1987, 4: 677), and footnotes 2, 10, and 15.

import substitutes along with developing more transaction-cost efficient non-specie alternative media-of-exchange methods for executing domestic trades.

## 2 The motivating debate

### 2.1 The claim that specie was chronically scarce

Colonists in British North America complained that specie (gold and silver coins) for executing domestic transactions was chronically scarce. Their complaints were ubiquitous and insistent.<sup>4</sup> These colonies did not produce specie, as gold and silver were not yet mined there; besides the British Crown did not allow them to mint coins after 1688 (Barth 2021; Goldberg 2023: 116–17; Grubb 2024; Nettels 1934: 276). They acquired specie, mostly from Spanish America, in exchange for exported goods. Colonists complained that as quickly as specie money was imported, it was re-exported, mostly to England, to buy imported goods. Contemporary accounts claimed that, in the absence of specie money, domestic transactions were executed using some form of barter and alternative local media-of-exchange (ALME) structures, namely book credit, commodity monies such as tobacco and beaver pelts. Eventually local legislature-issued paper bills of credit (bond-type debts) served as a local media of exchange. All these non-specie media of exchange were less transaction-cost efficient than using specie money. Using non-specie methods to execute

<sup>4</sup> See *Archives of Maryland* (1883–1972: 14: 174, 390–1; 39: 92; 61: 265; 62: 133; 63: 242), Baxter (1965: 11–12, 2004), Bezanson et al. (1935: 322), Breen (2004: 98), Brock (1975: 1–18, 25–29, 70–76, 86–87, 92, 106–108, 113–15, 137, 141–45, 150–51, 154, 165–66, 169, 176, 230, 240–41, 267–68, 283, 324, 333, 350–51, 353–56, 361, 386–88, 413, 429–31, 438–39, 443–45, 447, 456, 462, 464, 466, 468, 497, 524, 529, 532, 536, 550), Bullock (1900: 125–28, 143–44, 153, 161, 167–69), Bush (1977: 301, 1986: 212), Clark et al. (1886–1907, 3: 294; 4: 178; 5: 234–35, 851; 6: 1,274, 1,282; 7: 61–88, 394, 572, 928; 9: 142; 23: 781), Davis (1964, 1: 55, 62, 70–71, 113–14, 123, 131, 144, 155, 177, 183–87, 189, 192–93, 200–204, 210–12, 233–34, 254–55, 259, 270, 298, 310–11, 320, 336–37, 352–61, 379, 387, 398, 401–403, 407–408, 418–35; 2: 7–9, 23, 27, 67, 69–89, 98, 101, 112–13, 150–55, 165–69, 174–76, 184, 234–35, 237, 280, 293–94, 307, 312, 321, 379, 396, 433–34, 449, 453–54; 3: 3–4, 35–36, 67, 80–87, 94–96, 130–33, 145–46, 152–56, 160–67, 172–74, 193–95, 198–200, 203–204, 207, 211–13, 225–26, 256, 276, 289, 297, 314, 339, 341, 370–72, 386–87, 391, 406–407, 412, 430, 439–40, 446–47, 450–52, 456, 462–67, 474; 4: 4, 22–23, 33–34, 56, 110, 120, 150, 193–98, 211, 234, 380–82, 390–91, 416–17, 437–42, 452); Ernst (1973: 199–206), Fisher (1911: 273, 289–90, 294), Flynn et al. (2018), Grubb (2004, 2006a, b, 2019b), Hammond (1957: 11), Hening (1819, 6: 467), Kemmerer (1939: 868–69, 1940: 121, 123, 282, 304, 1956: 107–12, 137–39, 142), Labaree et al. (1959–1974, 1: 14, 152; 4: 345–48; 5: 194–95, 244, 246; 7: 123; 9: 147; 11: 13; 13: 449, 466–67; 14: 33–34, 38, 77–87, 232, 286–87; 16: 2, 254; 18: 135), Lester (1938: 326–28, 330–38, 346–48, 351, 359–60, 368, 1939: 184, 186, 188–90, 208, 213), McCusker (1978: 117–18), McCusker and Menard (1985: 338–41), Mitchell et al. (1896, 3: 324, 389; 4: 98, 322, 344), Nettels (1934: 8, 11, 13, 20, 59, 79–80, 84–85, 91–94, 99, 120, 126–27, 144–46, 151, 157, 160, 162–78, 202–28, 231–49, 253–55, 276, 279–83), New Jersey Historical Society (1852: 53, 59, 136–37, 167, 221–23), New Jersey, Legislature, General Assembly (1717: 18 [16 January 1716]), Newell (1998: 116, 118, 120, 135, 173), Perkins (1994: 13, 17, 19–23, 26, 51–55, 78), Redish (1984: 713, 727–28), Ricord and Nelson (1885, 9: 135), Wallace and Zhou (1997: 556), Weiss (1970: 773–74), Whitehead (1882, 5: 87–88, 91, 254, 423; 6: 134–35, 137). In addition, the preambles to almost ever colonial paper money law state that specie is scarce. Many more such contemporary statements of chronic specie scarcity can be found.

domestic transactions reduced the quantity of domestic transactions, thereby constraining economic development.<sup>5</sup>

## 2.2 The claim that specie was not chronically scarce

On the other hand, some scholars and some colonists argue that chronic specie scarcity in colonial North America is a myth.<sup>6</sup> People always complain about not having enough money. Thus, ubiquitous complaints of specie scarcity do not mean that specie is chronically scarce. The colonies were small open economies. If specie was needed to execute domestic transactions, more would be imported and less exported. Globally, specie flowed to where it was in short supply (more highly valued). Chronic specie scarcity, absent government intervention, was not possible. If specie was scarce, it could only be because colonial governments caused its scarcity by emitting paper money that drove specie money out of the colony. In 1752, David Hume stated, “Before the introduction of paper-money into our colonies, they had gold and silver sufficient for their circulation. Since the introduction of that commodity, the least inconveniency that has followed is the total banishment of the precious metals. And after the abolition of paper [money], can it be doubted but money [specie] will return...” (Rotwein 1970: 69).

Under the quantity theory of money in an open economy with an operative specie-flow mechanism, if specie money is scarce domestically, then domestic prices will decline to accommodate the smaller money supply. As domestic prices fall, the locale’s exports become more competitive abroad, and imports to the locale look

<sup>5</sup> Gresham’s law (bad money drives out good) is irrelevant to explaining the specie scarcity issues raised by the colonists. Gresham’s Law is not a general or universal law but is operable only under particular circumstances and constraints. First, Gresham’s Law requires that the bad money and the good money be held at a rate of exchange (usually by government force) that is different from that determined by supply and demand in the marketplace. Or that the bad money and the good money be indistinguishable by the lay public. Second, by “drives out,” Gresham’s law means that the good money ceases to exist as money or even ceases to exist as a physical thing. Finally, Gresham’s Law primarily applies to the minting of debased coins by the sovereign. None of these conditions hold in colonial America. The colonies are not minting specie coins let alone minting a mixture of full-bodied coins (good money) and debased specie coins (bad money). Specie coins (good money) are not drive out in the sense of ceasing to be money or ceasing to physically exist. Specie coins are still used as money at their full market value, they are just being used to buy a particular subset of goods, namely imports. The colonists could easily distinguish between the different media of exchange available (good money being specie coins and bad money being all else that could media an exchange), and they were free to price the different media of exchange as they saw fit in the marketplace. As such, Gresham’s Law is inapplicable and so irrelevant to the problem at hand and to the transaction cost model devised here to explain it. On Gresham’s Law, see Eatwell et al. (1987, 2: 565).

<sup>6</sup> See Brock (1975: 83, 114–15, 166, 268–69, 286–87, 304–305, 313, 322, 354–55, 362, 386–88, 395, 439, 447, 457, 485–86, 503–504, 523, 529, 536, 561–62), Davis (1964, 1: 34–35, 351, 401–402, 418; 2: 8, 25–26, 32, 49–51, 78, 82, 282, 321–23, 326–30, 379; 3: 235–36, 246, 259–60, 313–14, 341–42; 4: 8, 55–56, 62, 85, 157, 200–201, 380, 387, 391, 400–402, 416–19), Grubb (2006a, b), Kemmerer (1940: 121–22; 1956: 107, 122, 140), Labaree et al. (1962, 5: 245, 1970, 14: 77), Lester (1938: 344, 352, 363, 374), McCusker and Menard (1985: 338–41), Michener (1987), Michener and Wright (2006a, b), Nettles (1934: 88–89, 203–205, 207, 249, 280–82), New Jersey Historical Society (1852: 222), Perkins (1994: 18–19, 22–28, 53–55, 81), Redish (1984: 713–14, 727–28), Ricord and Nelson (1885, 9: 407, 412), Rotwein (1970: 69), Wallace and Zhou (1997: 556), Weiss (1970: 773–74, 783).

less attractive relative to domestic goods. Exports increase which brings in more specie, and imports decrease which reduces specie outflow. This replenishes the locale's specie money supply to desired levels. As such, chronic specie scarcity cannot exist. Temporary specie scarcity is possible due to unexpected disruptions to the balance of trade, but market forces in an open economy will correct these imbalances. Ocean tides and storms exist, but sea level is sea level everywhere.

In this scenario, colonial complaints of specie scarcity were an outcome of currency substitution. When a colony emitted an inside paper money, with a supposed fixed exchange rate to specie money, that paper displaced specie coins for use in domestic transactions.<sup>7</sup> Specie scarcity occurred when enough paper money was produced to completely displace specie for executing domestic transactions. In other words, the colonists themselves caused the specie scarcity of which they complained. If no paper money were emitted, specie would be plentiful enough to execute all domestic transactions as Hume claimed (see above).

While specie can be driven out by currency substitution, money per se is not made scarce by this mechanism. Being held at a supposed fixed exchange rate with specie, paper money is a perfect substitute for specie money. Domestic transactions do not resort to barter, and so chronic specie scarcity has no impact on the real economy. As such, the colonists were misguided, and their complaints of chronic specie scarcity should not be taken seriously. Either chronic specie scarcity did not exist, or it did not matter. As such, no monetary constraints on internal economic development occurred.

### 2.3 Taking the colonists seriously

If we take the colonists seriously and accept that specie was chronically scarce for executing internal trades even before colonial legislatures issued bills of credit (paper money)—as Benjamin Franklin noted—then we need a rational choice model that yields such an outcome and explains why the quantity theory of money within a specie-flow mechanism does not operate to overcome that scarcity.<sup>8</sup> The stylized

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<sup>7</sup> Some scholars claim that colonial paper monies were held in a constant fixed exchange rate to specie money, see Michener (1987), Michener and Wright (2006a, b). This claim turns out to be patently untrue. Colonial paper monies were only set at a fix exchange rate to specie money at the date of redemption (maturity) for said paper monies, much like that for any bond. At all other times a paper money's value to specie was free to fluctuate. Market forces determined that exchange rate fluctuation. Colonial governments had no ability, nor did they try to defend any constant fixed exchange rate except for at the date of redemption. See Cutsail and Grubb (2021), Grubb (2006a, b, 2016a, b, 2018, 2019b, 2024), McCusker (1978).

<sup>8</sup> Benjamin Franklin claimed that (1) specie was chronically scarce, and (2) this scarcity predates the issuance of paper monies by colonial assemblies. The modeling exercise here is thus an exercise in taking Franklin seriously. Franklin was recognized as the preeminent American of his generation in science, statesmanship, and letters. He wrote pamphlets, treaties, and correspondences on paper money. He designed and printed paper money for various colonies. As an assemblyman for Pennsylvania, he was involved in the debates over, and management of, that colony's paper money. Later, as a lobbyist at the British court, he addressed conflicts over paper money between Britain and her colonies. As such, Franklin's views should carry weight. On Franklin, see Grubb (2006b, c), Labaree et al. (1959–1998), Morgan (2002), Spiegel (1987), Talbot (2005).

facts embedded in the model are: (1) The polity starts off underdeveloped in that many goods desired can only be cost-effectively acquired via imports. The ability to engage in import substitution via domestic production only comes later with sufficient internal economic development. (2) The polity cannot produce the money used by the outside world in global trade, i.e., the outside money (specie), and so must export goods to acquire that outside money to subsequently use to execute internal trades. (3) The polity is colonially constrained in their ability to use trade controls and other legal devices to prevent the imported outside money (specie) from flowing back out to buy the desired imported goods. (4) The polity is colonially constrained, but not absolutely prevented, from developing domestic inside media-of-exchange structures to aid in the execution of local trades. An inside money is money that loses a substantial value when crossing polity borders and so cannot be exported to any great advantage.

These features also fit the vent-for-surplus characterization of early colonization. The colonies focused on producing exports to acquire foreign exchange to buy imports, with non-export domestic production left underdeveloped. Internal development and expanding domestic trade are constraining problems with which these economies struggle. These features lead to the incentive within these polities to develop inside monies or ways to transact domestic trades without using an outside money. The variety, character, and effectiveness of inside monies, how inside and outside monies can co-exist without local governments holding them in a fixed relationship, and how nascent inside media-of-exchange structures can impact economic development, present a rich global history of puzzles that need better sorting out.

### 3 Basic modeling considerations regarding "money"

#### 3.1 Modeling foundations: the Arrow–Debreu–Walrasian general equilibrium model

When economists model an economy, they start with the theory of value determination in a general equilibrium setting. The benchmark model in price theory is the Arrow–Debreu formalization of the Walrasian general equilibrium model. No money and no transaction costs are in this model. Goods trade for goods until their relative prices adjust, namely adjust in terms of what one good will trade for in terms of other goods, so that all markets clear thereby yielding a Pareto optimal outcome for society (Banerjee and Maskin 1996: 955–61, Eatwell et al. 1987, 1: 116–124, 4: 853–871, Starr 2012: viii-35). At best, there could be a *numeraire* good used to price all other goods in—a unit of account, but that *numeraire* good is indeterminate and so irrelevant in the system. The unit of account could even be a fictitious unit with no physical representation. The absolute numerical level of such a fictitious unit of account is also indeterminate and so irrelevant in the system. All that matters is the matrix of relative prices, or trading ratios of goods to other goods.

In the Walrasian–Arrow–Debreu general equilibrium model, real goods trade for real goods without using money and without incurring transaction costs. There is nothing in the model that says goods cannot transit across people before all markets

clear. Real goods can mediate exchange without it being “money” unless you just willy-nilly conflate the two concepts. Thus, in the Walrasian–Arrow–Debreu general equilibrium model “commodity” monies, such as tobacco in colonial Maryland and Virginia, are not “monies” per se, but are just goods trading for goods. I call the prices generated within the Walrasian–Arrow–Debreu general equilibrium model the “barter price” for real goods within the local economy. This is true even when using an alternative local media-of-exchange structure (ALME), such as a “commodity” or unit of account money, to execute domestic transactions as long as it just entails real goods being exchanged for real goods.<sup>9</sup> To get money into the Walrasian–Arrow–Debreu general equilibrium model requires introducing some trade frictions or transaction costs.<sup>10</sup>

### 3.2 Money and barter in the quantity-theory-of-money, specie-flow mechanism

If credence is given to the colonial writers who assert that specie was chronically scarce, then there must be an explanation for the failure of the equilibrating effect predicted by the quantity-theory-of-money, specie-flow mechanism. The transaction-cost model developed here provides that explanation by relaxing two implicit assumptions embedded in the quantity theory’s characterization of colonial economies, namely the assumptions that all goods are tradable goods, meaning they can cost-effectively cross polity borders, and that all transactions use specie coins (namely there is only one money or medium-of-exchange in use).<sup>11</sup> Instead, colonial economies are assumed to produce and consume both tradable and non-tradable goods, e.g., tobacco and horse racing, respectively. Only some goods can be exported for specie money (tobacco, flour, rice), and only some goods can be obtained through imports bought with specie money (tea, sugar, Madeira wine). These imports are assumed to have no domestically produced near-substitutes (Lester 1938: 329). Finally, many domestic goods cannot be cost-effectively exported nor can imports be cost-effectively substituted in their place, e.g., hay, firewood, and horse racing. These goods are produced and traded only within the domestic economy (Davis 1964, 1: 353; 3: 376–78). I will call these goods “non-tradable” in the sense that they are not traded outside the domestic economy, either directly or in the form of a close substitute good.

<sup>9</sup> I do not restrict the definition of “barter” only to trades where a double coincidence of wants exists (which is a common definition of “barter”). Such a common definition is too narrow in that almost no such trades occur. I define barter as real goods and real assets trading for real goods and real assets, or trading for explicit claims to real goods and real assets. This aligns the definition of “barter” with the Arrow–Debreu formalization of the Walrasian general equilibrium model for determining relative prices and so are called “barter” prices here.

<sup>10</sup> See Banerjee and Maskin (1996: 955–61), Eatwell et al. (1987, 4: 676–9), Starr (2012). See also footnotes 2, 3, and 15.

<sup>11</sup> The quantity-theory-of-money, specie-flow model for the pre-nineteenth century colonial world assumes that the transaction opportunity cost of using specie coins is infinite. No alternatives to specie money for executing exchanges exist. The non-applicability of this assumption is at the heart of alternative money or media-of-exchange creation in colonial America. For applications of the quantity theory of money to colonial America, see Cutsail and Grubb (2021), Grubb (2004, 2016b, 2019a), McCallum (1992), Smith (1985a; b; 1988), West (1978), and Wicker (1985).

In addition, it will be assumed that colonial economies engage in both monetized-in-specie and non-monetized-in-specie transactions. Barter and alternative localized media-of-exchange structures (ALME) with varying degrees of transaction-cost efficiency can be used to execute domestic transactions. These alternative methods do not have fixed or defended exchange rates between them, but only variable market-determined exchange rates between them. This assumption makes using the simple quantity theory of money within a specie-flow mechanism problematic. Barter alternatives put a price floor under which the specie price of non-tradable goods cannot fall. If all specie leaves the economy, then under the quantity theory of money, prices must be bid down to zero. This cannot happen when barter has some efficiency in executing domestic transactions.

Export and import prices are set in world markets and do not respond to local specie scarcity. When specie in a colony becomes scarce, specie prices for domestic transactions of non-tradable goods fall toward their “barter” price alternative. The relative price of that colony’s non-tradable to tradable goods falls, but only so far—the fall constrained by the “barter” price floor. Therefore, if the elasticity of substitution between non-tradable and tradable goods is low, the consumption of the two types of goods will not change enough to overcome the lack of specie money for transacting domestic non-tradable goods.

The specie price of non-tradable goods can only fall to its “barter” price alternative, which is not low enough to draw specie money into executing domestic transactions instead of buying imports. That is, domestic goods will be exchanged by “barter” at a specie-stated price, leaving existing specie money to be used to buy imported goods. The fall in the specie price of non-tradable goods, compared with tradable goods, pushes the colonists toward export goods production, i.e., the staples or vent-for-surplus thesis, with the specie earned from exports being immediately re-exported to purchase imports (Labaree et al. 1959, 1: 144–45; Lester 1939: 210, 212; McCusker and Menard 1985: 17–34). Increased specie “pass-through,” keeping specie money chronically scarce for executing domestic transactions, results.<sup>12</sup>

### 3.3 Institutional and regulatory constraints on colony-created money

Colonial governments could not create *real* money per se. That was the prerogative of the British Crown (Davis 1964: 1: 271; 4: 206, 219; Nettels 1934: 276). Even if the colonies possessed gold and silver bullion—either mined or imported—the Crown prohibited them after 1688 from minting their own specie coins (Barth 2021; Goldberg 2023: 116–17). Colonial governments could, however, create transactionable or exchangeable debt in the form of paper *bills of credit*. The notion of money as tradable debt was closely tied to what the colonies were allowed to create (Newman 2008: 10). A colony’s paper money—its bills of credit—had a bearer-bond quality that required an explicit redemption exercise to extinguish the principal

<sup>12</sup> Redish (1984), Redish and Weber (2008), and Wallace and Zhou (1997) explain specie scarcity by the low quality and indivisibility of the coins used. By contrast, the model here assumes that people are smart enough to figure out how to create change and evaluate coins (as embedded in the model’s specie transaction-cost function). See Davis (1964, 2: 453–54).

expressed on its face (Cutsail and Grubb 2021; Grubb 2016a, b, 2018, 2019b, 2020, 2024).

The British government through the Board of Trade and the proprietors of some colonies exercised oversight of colonial paper money legislation (Brock 1975; Cutsail and Grubb 2021; Grubb 2016a, 2019b). The British Parliament also constrained colonial paper money creation. In 1741, Parliament extended the 1720 Bubble Act to the colonies. This made joint-stock corporations, except those chartered by the Crown, illegal (Harris 1994; Newell 1998: 228–30; Priest 2001: 1379; Smith 1937: 304). Thus, banking operations in the colonies were made prohibitively costly in terms of being able to adequately raise capital and spread risk among stockholders. Joint-stock banks emitting paper banknote money backed by fractional specie reserves would not appear until the American Revolution ended British rule.<sup>13</sup>

Problems with New England's paper money led Parliament to pass the Currency Act of 1751 (Brock 1975: 168–243; Newell 1998: 231–33; Priest 2001: 1383–84). This act applied only to New England. It outlawed making bills of credit a legal tender in private transactions. It also restricted the emission-to-final-redemption interval to a maximum of two years in peacetime and five years during wartime. Problems with Virginia's bills of credit in the early 1760s led Parliament to pass the Currency Act of 1764 (Brock 1975: 465–528; Ernst 1973: 77–88). This Act applied to all the colonies and outlawed making bills of credit a legal tender. After colonial protests, Parliament in 1773 amended the Currency Act of 1764 to allow bills to be made a *de jure* legal tender for public debts, i.e., for paying the taxes and fees levied by the issuing government (Ernst 1973: 282–311).

Finally, the British government did not allow the colonies to implement capital-trade controls that would inhibit the exportation of specie from the colonies. By contrast, the British government restricted the free exportation of specie from Britain (Perkins 1994: 13). Colonial treasuries never held specie reserves in any meaningful quantities. They functioned primarily as intermediaries between local tax revenue inflows and colonial assembly spending outflows.

In the absence of outside specie money and inside local government paper monies, local within-colony exchanges are mediated in some alternative way to crude barter, that is barter as commonly articulated by economists. It was not the crude barter that requires a double coincidence of wants for exchange to be consummated. Colonists did not go door to door with piglets under their arms searching for neighbors who had and were willing to trade boxes of candles for said piglets. The high transactions cost of this kind of barter explains why it was not commonly observed. The non-specie-money local media-of-exchange structures that colonists developed was what will be termed an efficient (relative to crude barter) alternative localized media of exchange (ALME). Efficient ALME structures entailed exchange organized around shop-notes, store book credit accounts, and tradable individual bonds with local goods priced in common units of account which allowed easy relative pricing and account clearing across multiple trades and traders or around commonly

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<sup>13</sup> The first successful joint-stock specie-based bank in America was the Bank of North America chartered in 1781 (Hammond 1957).

exchanged local goods that most everyone knew, used, or possessed.<sup>14</sup> Centralized clearing of credits and debts obviated the double coincidence of wants problem. These efficient ALME structures for executing domestic transactions had already displaced specie money before colonial legislatures issued paper monies.

### 3.4 Caveats and considerations

A caveat to how transaction costs are attached to using different media of exchange must be noted as it is key to making the following model produce a chronic specie scarcity outcome. A specie coin used to execute a local trade is assumed to be preferred, other things equal, because the transaction costs of using a specie coin is assumed to be lower than the next best alternative transacting method. If that specie coin continuously circulates in the local economy consummating a series of local trades, then the cumulative net transaction-cost gains from its on-going use in consummating local trades, relative to the next best alternative transacting method, represent a positive externality. Therefore, to make the following model yield a specie scarcity outcome the assumption that the original possessor of that specie coin cannot capture or internalize that positive externality is required. In other words, the transaction costs attached to using different media of exchange are assumed to be confined only to that current trade.

If the original possessor of the specie coin could perfectly capture or internalize the net transaction-cost gains from all future local trades using that specie coin, then future traders would be indifferent between using specie coins and the next best alternative media of exchange. Thus, no “specie” scarcity could exist. The original possessor of the specie coin could do this by requiring a lower relative price for the good being initially purchased that equals all future transaction-cost gains when purchased with a specie coin compared with when purchased using the next best alternative media of exchange. The new holder of the specie coin would then have to make the same future net gain calculation from passing that specie coin on to the next trader. Each subsequent trader would have to make the same calculation, namely balancing the reduction in the relative price of the good purchased when using a specie coin with all the future expected net transaction-cost gains from the subsequent use of the specie coin in the domestic economy compared with using the next best alternative media of exchange. Again, if this happens, the following model falls apart and specie scarcity does not occur.

That such internalization of this positive externality does not happen, and so the following model works as presented, is supported by several observations and some logic. First, relative goods prices in colonial America do not vary by the media of exchange used. Prices vary for the same item to capture time-discounting

<sup>14</sup> See Baxter (1965: 14, 16–38; 2004), Brock (1975: 430–31, 466, 509, 532), Bush (1977: 301), Davis (1964, 1: 113, 204, 400, 435–37; 2: 48, 70–71, 75, 80, 236, 368, 373, 375–76, 453–54; 3: 189, 204, 229, 406–407, 424, 430, 447, 450, 458, 474; 4: 57, 107, 109, 137), Flynn et al. (2018), Hening (1819, 6: 467), Kemmerer (1939: 868–69, 1956: 108–110), Lester (1938: 331–32, 372, 1939: 208), McCusker (1978: 117–18), Nettels (1934: 59, 99, 120, 126, 157, 160, 162–78, 185, 195, 208–28, 250–55), Newell (1998: 118), Perkins (1994: 57–62, 67, 381–82).

when exchange involves credit, but contemporary goods prices do not vary to capture net differences in the future transaction-cost gains from using different media of exchange. Second, transaction costs involve a bewildering complexity unique to each trade, making transaction costs difficult to quantify for future trades that do not involve the original parties to the first trade. Transaction costs of each trade are largely experiential events of the traders involved at the point of exchange. Uncertainty of what and when future trades will take place, and who and what will be involved in said trades, make forecasting what the total future net transaction-cost gains will be and how to monetize them into the original current transaction impossible.<sup>15</sup>

An important consideration to making the following model produce a chronic specie scarcity outcome is the inability to produce import substitutes by the local economy—with desired imports being only purchasable with specie coins. If imports have no domestic substitutes, then an additional opportunity cost to using specie coins to execute domestic trades exists. This opportunity cost leads rational colonists to export their specie coins and not use them in the local economy, thereby causing chronic specie scarcity in the colony. If this opportunity cost did not exist (if domestic goods and desired imports were perfect substitutes), then specie scarcity could not exist in the model below. Social welfare and internal economic development is affected by the combination of that opportunity cost with what governs the transaction costs of using non-specie methods of executing local trades. The model will show that there is a cross-over point from sub-optimal to optimal social welfare outcomes in the evolution in local non-specie monetary transacting methods even when specie coins remain chronically scarce.

#### 4 A transaction-cost model of chronic specie scarcity

What follows is a transaction-cost model of monetary choice.<sup>16</sup> It takes the colonists seriously in their claims that (1) specie money was chronically scarce for executing domestic trades and paying local taxes, and (2) this scarcity predates the emission of

<sup>15</sup> See footnotes 2, 3, and 10. Bills of credit (paper money) issued by colonial legislatures often circulated at a transaction premium within the respective colony of issue above their pure barter or real asset price. This premium, however, was tiny, namely just a couple of percentage points of the bill's non-money-usage real asset value. This premium was just enough to make the bills the preferred medium of exchange within that colony compared with using the next best non-specie media-of-exchange structure. In other words, the premium was primarily the result of transaction-cost gains in the current trade only. It was not enough to internalize all future transaction-cost gains from using said bills. In Fig. 3, the extra transaction premium attached to the domestic use of a specie coin that fully internalize all future transaction-cost-gains from the subsequent use of that coin in the domestic economy would be area  $(n - I)$   $(A + B + C)$ . This amount dwarfs by a wide margin the positive transaction premium estimated to be attached to paper bills of credit. See Cutsail and Grubb (2021: 471–72), Grubb (2016b: 1225–27, 2018: 130–32, 2024: 1739).

<sup>16</sup> Models of monetary choice are typically complexly abstract constructions of artificial economies; e.g., see Cavalcanti and Wallace (1999a, b), Kiyotaki and Wright (1989), Niehans (1971), Ritter (1995), Starr (2012). By comparison, while using concepts from this literature, the model here is more heuristic, uncomplicated, historically grounded, and so more accessible to an economically educated general reader.

legislature-issued colony-specific inside paper monies. The ability to develop relatively efficient non-specie alternative local media-of-exchange structures (ALME) for executing domestic transactions and the fact that imports can only be purchased with specie money or specie credits are used to demonstrate that chronic specie scarcity in these colonies was possible, despite unrestricted specie-market arbitrage. The model proceeds through four figures that follow the historical sequence of trade and monetary (media-of-exchange) development in colonial North America.

#### 4.1 Modeling assumptions and terminology

The model assumes a small open economy/polity, e.g., an individual British North American colony, with  $n$  people. All people are assumed to have identical demands for domestic transactions, i.e.,  $\text{Demand}_i = \text{Demand}_j = \dots = \text{Demand}_n$  with each being a normal downward sloping curve. Domestic transactions are any trades between people within this polity. The particular good being traded does not matter. Thinking about the “good” as just a quantity of “transactions” may seem unconventional, but it captures the essence of the general economy in that each and every trade within the colony is voluntary and welfare enhancing to the trading parties. It also allows introducing transaction costs into a simple microeconomic demand model.

Specie money or specie credits (sm) are exogenous or outside money. It is the money the rest of the world uses to consummate transactions that cross polity borders. Specie is not produced or minted in this polity. In exchange for exported goods, specie money is imported. No barriers to foreign trade or specie flows exist. Imported goods can only be purchased with specie money or specie credits. Domestically produced goods cannot be easily substituted for imported goods. Domestically produced goods can be purchased within this polity with specie money (sm), or via some non-specie-money exchange method ( $b$ ). These non-specie exchange methods include using direct or crude barter (cb) or by using some alternative local (inside) media-of-exchange (ALME) method. The transaction costs (TC) of using these non-specie-money methods ( $b$ ) to consummate an exchange are always higher than when using specie money, i.e.  $(\text{TC}_b > \text{TC}_{\text{sm}})$ , is always true.

Specie money has a separate opportunity cost ( $\text{OC}_{\text{sm}}$ ) when used for domestic transactions, namely the imported goods that could have been purchased only with that specie money.<sup>17</sup> When specie money and non-specie-exchange methods cannot be used to execute local trades, the outcome is autarky ( $Y_{\text{autarky}}$ ), i.e., an individual

<sup>17</sup> The opportunity cost of specie is the amount the utility value of imported goods exceeds the utility value of domestic goods purchased with the same amount of specie. Money’s use as a medium of exchange rather than a store of value is the primary focus. This is relevant when alternative means of executing domestic transactions are present. Economists typically use the interest rate to measure the opportunity cost of money. This application assumes there are no transacting alternatives to money, thus making money-holding sensitive only to the returns on non-money assets. As late as 1774, colonists held only 2 percent of their wealth in cash, thus making money’s asset-holding function less relevant than its medium-of-exchange function (Perkins 1994: 55). If there are no alternatives to specie for executing domestic transactions, or if domestic goods are perfect substitutes for imports, then the medium-of-exchange opportunity cost of using specie is zero, and the opportunity cost to holding specie becomes only the interest rate.

produces and consumes his own goods without trading with others in the polity. Non-specie methods ( $b$ ) to execute local trades have no separate opportunity cost ( $OC_b=0$ ). They cannot be used to purchase imported goods, and the demand curve for domestic transactions captures the autarky alternative outcome to not using specie money or non-specie transacting methods.<sup>18</sup>

Individuals are price-takers in the market. Thus  $TC_b$ ,  $TC_{sm}$ , and  $OC_{sm}$  are perfectly elastic, namely the transaction costs for each mode of exchange is the same for each successive exchange using that mode (a modeling simplification). Individual economies/polities are small compared with their respective global markets and so are price-takers with regard to imports and exports that cross their borders. Direct barter and alternative local media-of-exchange (ALME) structures are assumed to have a hierarchy of transaction-cost efficiencies relative to using specie money. While  $TC_b > TC_{sm}$  is always true, the gap between them can vary. ALMEs are endogenously created inside methods for executing domestic trades. Different structures among ALMEs can yield different transaction-cost efficiencies.

Three different non-specie local trade-executing structures are used. Figures 1 and 2 assume relatively inefficient *crude barter* (cb), i.e., domestic trade via a double coincidence of wants. A man with a pig who wants to trade that pig for a particular box of candles searches for a man with the desired box of candles willing to trade it for that exact pig. Figure 3 assumes a more efficient ALME structures (eb), such as domestic trade organized around a third-party storekeeper who uses book credit or shop-notes to clear domestic transactions and private citizens using a common local commodity to media a domestic transaction. Unlike crude barter, efficient ALME structures possess some localized credit-money characteristics with store debits and credits transferable across store customers, setoffs among a group of traders, some expectation of commodity media-of-exchange quality and value, and private contract execution based on personal reputation and personal inspection to make the exchange work.

Figure 4 assumes enhanced efficient ALME structures (eeb), such as when the polity's government creates an inside paper money or credit/debt instrument that can be used for domestic transactions throughout the polity. These paper monies cannot be used to acquire imported goods in the sense that the foreign seller will not accept them outside the polity. Nevertheless, these localized media-of-exchange paper monies possess support by, and rely on the reputation of, the local government for their value and so may become the preferred local media-of-exchange throughout the polity compared with efficient ALME structures as used in Fig. 3 which are more restrictive and localized in usage within the polity.

An initial stock of specie money acquired from prior-period exports in the hands of Demander <sub>$i$</sub>  is exogenously given, i.e., the starting point in the model. Will Demander <sub>$i$</sub>  use this specie money to execute domestic transactions or export it to acquire imported goods, thereby removing this specie money from the polity so that it cannot serve as a medium of exchange in subsequent domestic transactions?

<sup>18</sup> The model requires only that  $OC_{sm} > OC_b$  so that "net"  $OC_{sm} > 0$ .

#### 4.1.1 Terminology shorthand summary

Sm = specie money (gold and silver coins, plate, bullion).

OC = opportunity cost.

$Y$  = a specific quantity of transactions.

$Q$  = quantity of transactions.

TC = transaction costs.

$b$  = non-specie-money methods of executing local trades.

cb = crude barter used for executing local trades.

eb = efficient non-specie, non-polity-wide, localized media of exchange.

eeb = enhanced efficient non-specie, polity-wide, localized media of exchange.

$n$  = number of demanders in the polity.

ALME = alternative localized media-of-exchange structures.

#### 4.2 Baseline model: Figures 1 and 2

Figure 1 presents the baseline position upon which subsequent figures are built. It graphs the cost of domestic transactions against the quantity of domestic transactions. A standard downward sloping demand curve for a given individual is drawn. If costs are too high, no domestic transactions are demanded. The result is autarky ( $Y_{\text{autarky}}$ ). An individual produces and consumes his own goods without trading with others in the polity.

If the cost of domestic transactions is zero,  $Y_{\text{max}}$  is demanded. Constraints to domestic production, namely exogenously given resource and technology constraints in the production function and the gains to specialization across individuals in the polity, determine  $Y_{\text{max}}$ . The summation of  $Y_{\text{max}}$  across people in this economy approximates the maximum potential gross domestic product attainable. The transaction costs of executing domestic trades are always positive and so the quantity of domestic transactions demanded is less than  $Y_{\text{max}}$ .

The transaction costs of crude barter ( $TC_{\text{cb}}$ ) are substantially greater than the transaction costs of using specie money ( $TC_{\text{sm}}$ ) which, in turn, is somewhat greater than zero ( $TC_{\text{cb}} \gg \gg TC_{\text{sm}} > 0$ ). Several factors keep  $TC_{\text{sm}}$  above zero. Identifying counterfeit coins is costly, e.g., is that a silver or a pewter dollar? Carrying heavy metallic substances is costly. Determining whether specie coins have been debased, clipped, cut, worn, or otherwise adulterated in ways that reduce their value, or make them harder to identify, is costly. Making change may be difficult if small denominations are not minted. Finally, determining the relative value of different coins is costly, e.g., what is the value of a gold Spanish pistole compared with a gold English crown?

The high value of  $TC_{\text{cb}}$  in absolute terms, as well as relative to  $TC_{\text{sm}}$ , comes from the double coincidence of wants underlying crude barter. The cost of this kind of barter is so absurdly high that no one would engage in it except in rare cases. Assuming that crude barter is the only alternative to (specie) money is a standard trope used by economists to justify the existence of money (meaning only specie money

in this case) and its absolute primacy in trade.<sup>19</sup> Barter is so costly that domestic transactions will only take place using (specie) money. No transaction can take place without (specie) money, and no (specie) money can change hands without it being part of a transaction. In other words, the opportunity cost of using (specie) money is assumed to be nearly infinite. Assuming money rather than explaining different gradients of the media-of-exchange structures used in society allows economists to do money-price-output analysis without caveats.

Positing crude barter as the only alternative to (specie) money, however, assumes people are willfully stupid—a position anathema in economics. People search for and develop cost-minimizing non-specie-money localized media-of-exchange trading structures superior to crude barter. The subsequent figures relax this stupid-crude-barter assumption and explore what happens when cost-minimizing non-specie forms of efficient and enhanced efficient alternative media-of-exchange (ALME) structures are employed to execute domestic trades.

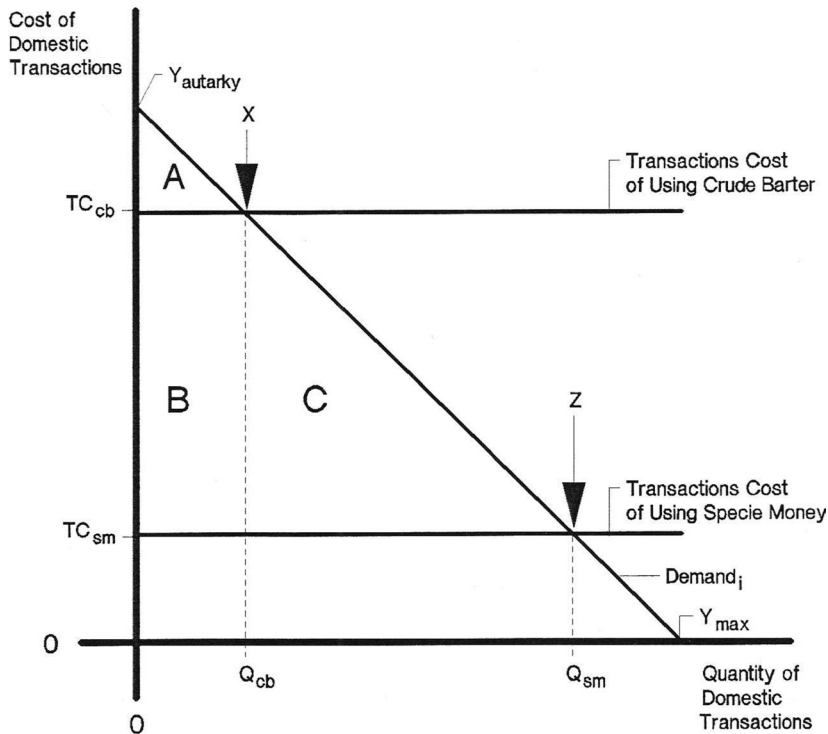
The outcome of the baseline model illustrated in Fig. 1 is straightforward. Comparing the equilibrium for using specie money, point Z, with that for crude barter, point X, shows that the quantity of domestic transactions is greater using specie, i.e.,  $Q_{sm} > Q_{cb}$ . More importantly, it shows that the consumer surplus (the area under demand that is above cost) is larger when using specie money than when using crude barter, i.e., area  $(A + B + C) > \text{area } A$ . The net welfare gains from using specie money are area  $(B + C)$ .

This outcome is true for the initial Demander<sub>*i*</sub>, as well as for each subsequent Demander<sub>*j* through *n*</sub>. Demander<sub>*i*</sub> starts with an initial stock of specie. His incentive is to use it, rather than crude barter, to execute domestic transactions. His net gain from doing so is area  $(B + C)$ . The person in the economy with whom he transacts now has that stock of specie money and faces the same conditions that Demander<sub>*i*</sub> faced in Fig. 1. This person will thus make the same decision.

As such, chronic specie scarcity for executing domestic transactions will not exist, and this use of specie money is welfare enhancing for the polity. Each individual gains area  $(A + B + C)$  when using specie money to execute domestic transactions compared with area  $A$  when using crude barter. No matter how many individual demanders ( $n$ ) participate in domestic transactions, it will always be true that  $n(A + B + C) > n(A)$ .

Figure 1 assumes a closed economy. Yet specie money initially entered this economy in exchange for exported goods. The initial presence of specie money assumes an open economy. Figure 2 adds an open economy to Fig. 1 by adding an opportunity cost of using the initial stock of specie money to execute domestic transactions ( $OC_{sm}$ ), namely the loss of the imported goods that could have only been purchased by Demander<sub>*i*</sub> with that specie money. The total cost of using specie money to execute domestic transactions is  $(TC + OC)_{sm}$ .

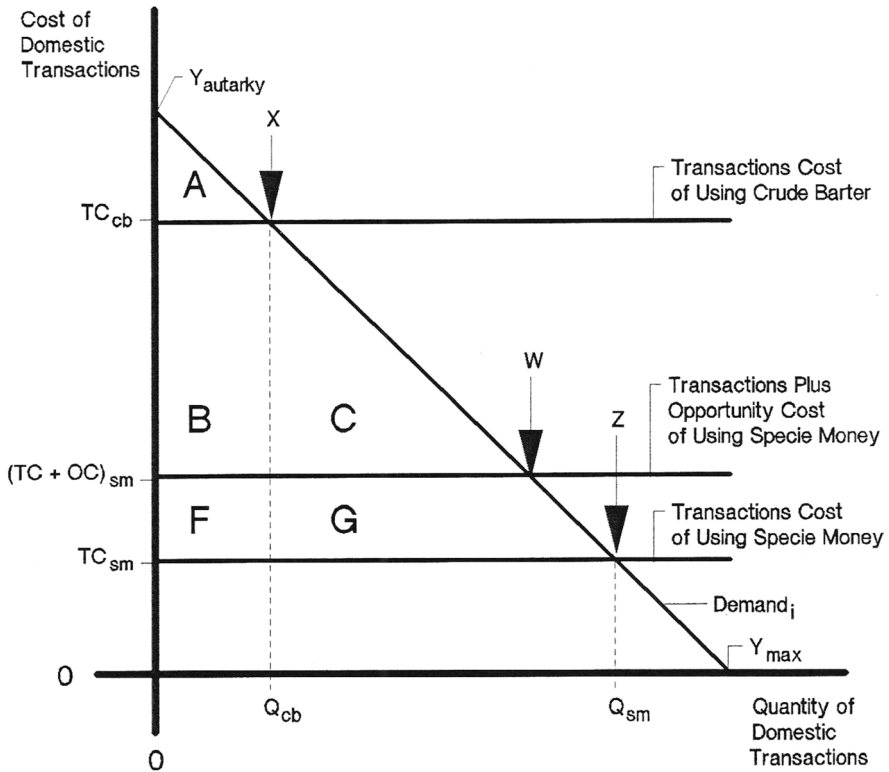
<sup>19</sup> For examples from eighteenth century writers, see Davis (1964, 1: 113–14, 122, 154–55, 212, 378, 403), Labaree et al. (1959, 1: 144–45, 148) and Smith (1937: 22–23, 32). Crude barter using a double coincidence of wants is more prevalent than most economists think. In grade school I routinely traded my Twinkie for a Devil Dog or Ho-Ho at lunch. At a Japanese restaurant when my wife and I both order mixed tempera appetizers, I routinely trade my tempera broccoli for her tempera shrimp. This kind of crude barter goes on all the time, but economists think too narrowly to see it.



**Fig. 1** The preliminary baseline model of domestic transactions in a closed economy

Adding an open economy does not change the outcomes in Fig. 1 as long as  $OC_{sm}$  is small compared with the gap between  $TC_{cb}$  and  $TC_{sm}$ . While the quantity of domestic transactions is still greater when using specie money, the welfare assessment of using specie money for consummating domestic transactions is altered. In Fig. 2, the consumer surplus from using specie money to execute domestic transactions for Demander<sub>*i*</sub> must be assessed at point *W* rather than at point *Z*, because there is an additional cost to using specie money for executing domestic transactions, namely the imported goods foregone that only the specie money could have purchased. If Demander<sub>*i*</sub> uses his specie money to buy imported goods, and so must use crude barter to execute his domestic transactions, he gains area  $(A + F + G)$ , e.g., the value of bartered domestic goods plus the value of imported goods. Alternatively, if Demander<sub>*i*</sub> uses his specie money to execute his domestic transactions and so foregoes buying imported goods, he gains area  $(A + B + C)$ , namely  $[(A + B + C + F + G) - (F + G)]$ . Comparing the welfare gains from using crude barter, area  $(A + F + G)$ , with the welfare gains from using specie money to execute domestic transactions, area  $(A + B + C)$ , hinges on comparing area  $(B + C)$  with area  $(F + G)$ .

If area  $(B + C) > \text{area}(F + G)$ , the choice of what to use to execute domestic transactions and the welfare outcome from Fig. 1 will not change. Demander<sub>*i*</sub> has an incentive to use his initial stock of specie money, rather than crude barter, to execute domestic transactions. His net gain is area  $[(B + C) - (F + G)] > 0$ . The person with



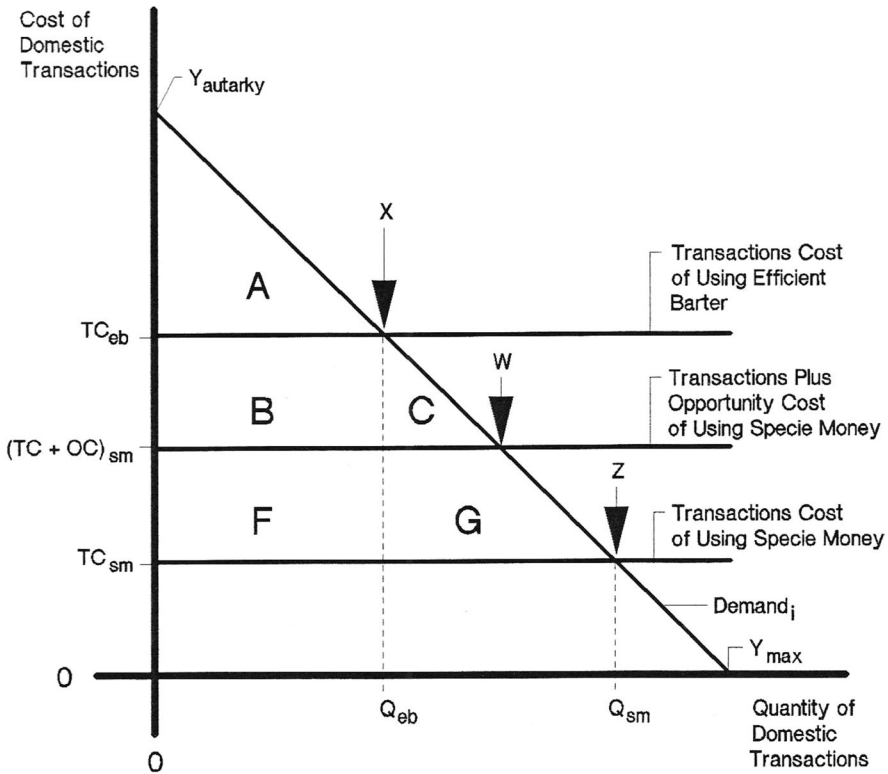
**Fig. 2** The preliminary baseline model of domestic transactions in an open economy

whom he exchanges his specie money for local goods now has that stock of specie money and faces the same conditions as Demander<sub>*i*</sub>. This person will thus make the same decision. The outcome that is true for the initial Demander<sub>*i*</sub> is also true for each subsequent Demander<sub>*j*</sub> through<sub>*n*</sub>.

Under the condition in Fig. 2, when area  $(B + C) > \text{area}(F + G)$ , chronic specie scarcity will not exist, and the use of specie money for executing domestic transactions, rather than crude barter, will be welfare enhancing. Each individual gains area  $(A + B + C)$  using specie money to execute domestic transactions compared with area  $(A + F + G)$  when using crude barter. No matter how many individual demanders ( $n$ ) participate in domestic transactions, it will always be true that  $n(A + B + C) > n(A + F + G)$ .

### 4.3 Efficient ALME: Figure 3

Figure 3 replaces the stupid-crude-barter assumption with a more efficient ALME structure. Efficient ALME structures are, basically, credit between reciprocating or network trading partners, priced in an accepted unit of account. In the colonial economy, this efficient ALME (eb) can be thought of as domestic trade organized



**Fig. 3** Adding efficient ALME structures to the model. *Note* “Using Efficient Barter” in the Figure refers to efficient ALME structures, see text

around a third-party central storekeeper who uses book credit or shop-notes as a kind of endogenous inside “money” for clearing transactions among customers and effectuating bookkeeping setoffs across accounts. It can also be thought of as private traders agreeing on how to use a common local commodity to media exchanges along with the quality and value assessments and private contract claims needed to make such exchanges work. Unlike crude barter, efficient ALME has some localized transferable credit-money characteristics.

$TC_{eb}$ , while lower than  $TC_{cb}$ , still exceeds that of the transaction and opportunity costs of using specie money for executing domestic trades, namely  $TC_{cb} > TC_{eb} > (TC + OC)_{sm}$ . However, Fig. 3 assumes that the opportunity cost of using specie money for domestic transactions ( $F + G$ ) is greater than the consumer surplus gained by using specie money rather than efficient ALME structures for domestic transactions ( $B + C$ ). That is, Fig. 3 assumes that  $(TC_{eb} - TC_{sm}) > OC_{sm} \geq (TC_{eb} - TC_{sm})/2$ .<sup>20</sup> While the quantity of domestic transactions is still greater when using specie money, the choice of the domestic transacting

<sup>20</sup> All that is required is that area  $(F + G) > \text{area}(B + C)$ . This is met by  $(OC_{sm} - \psi) \geq [(TC_{eb} - TC_{sm})/2]$  where  $\psi > 0$  by some amount depending on the elasticity of demand.

medium and the welfare outcome of this choice are different in Fig. 3 compared with that in Figs. 1 and 2.

If Demander<sub>*i*</sub> uses his initial stock of specie money to execute domestic transactions, his consumer surplus is area  $(A + B + C)$ , namely area  $[(A + B + C + F + G) - (F + G)]$  because he has to subtract the opportunity cost of the foregone imported goods that the specie money could have purchased  $(F + G)$  from his net gain at point Z. Alternatively, if Demander<sub>*i*</sub> uses his specie money to buy imported goods and uses efficient ALME structures to execute domestic transactions, his consumer surplus is area  $(A + F + G)$ , i.e., the gain from having the imported goods  $(F + G)$  plus the gain from the barter of domestic goods  $(A)$ . Given the assumption above that  $OC_{sm} \geq (TC_{eb} - TC_{sm})/2$ , the area  $(F + G)$  is always greater than the area  $(B + C)$ . Therefore, Demander<sub>*i*</sub> comes out ahead using his specie money to buy imported goods and using efficient ALME structures to execute domestic transactions. Any specie money that enters the polity will be immediately exported to buy imported goods and not be used to execute domestic transactions. Chronic specie scarcity for executing domestic transactions is the result.

While immediately exporting one's specie money to buy imported goods is the optimal behavior for each individual, it is not the welfare maximizing outcome for society as  $n \rightarrow \infty$ . If Demander<sub>*i*</sub> follows his individual welfare maximizing choice, then his specie money is no longer available for Demanders<sub>*j* through *n*</sub> to use for executing domestic transactions. Only Demander<sub>*i*</sub> gets the benefit of the imported goods that his specie money purchased. Each individual with an initial stock of specie money faces this situation. They cannot see nor capture the positive externality of having their specie money available for executing all subsequent domestic transactions by others in the polity.<sup>21</sup>

If Demander<sub>*i*</sub> follows his individual welfare maximizing choice, he receives area  $(A + F + G)$ . Because the specie money was exported, it is not available for Demanders<sub>*j* through *n*</sub> to use. Thus, Demanders<sub>*j* through *n*</sub> can only use efficient ALME structures to execute domestic transactions, with each receiving area  $(A)$  only. Thus, the total social welfare for all demanders in this polity is area  $(A + F + G)$  for Demander<sub>*i*</sub> and area  $(n - 1)A$  for the rest of society, i.e., for Demanders<sub>*j* through *n*</sub>. As such, total social welfare under this outcome is area  $[nA + (F + G)]$ .

By contrast, suppose each demander goes against his individual welfare maximizing choice and uses his initial stock of specie money to execute domestic transactions, foregoing the purchase of imported goods with his specie money. Because specie money is passed from one demander to the next, it circulates through the polity executing all domestic transactions. As such, each demander receives a welfare gain of area  $(A + B + C)$ . Because each demander in society gets this individual welfare, total social welfare is area  $n(A + B + C)$  or  $[nA + n(B + C)]$ .

Comparing the two outcomes shows that even when  $n$  is not large, and certainly as  $n \rightarrow \infty$ , social welfare is maximized by retaining specie money to execute domestic transactions and foregoing using the specie money to purchase imported goods,

<sup>21</sup> Outside money (specie), when used for domestic transactions, possesses public good qualities. When treated as a pure private good by individuals the standard under-provision of this public good for domestic use results (i.e., chronic specie scarcity arises). See footnotes 2, 3, 10, and 15.

i.e.,  $[nA + n(B + C)] > [nA + (F + G)]$ . The one-off benefit to Demander<sub>*i*</sub> of exporting his specie money for imported goods ( $F + G$ ) is exceeded by the subsequent foregone benefit of  $n(B + C)$  for all subsequent Demanders<sub>*j*through<sub>*n*</sub></sub> of not having that specie money available to execute their domestic transactions. In other words, while area  $(B + C) < \text{area}(F + G)$ , area  $n(B + C) > \text{area}(F + G)$  as  $n \rightarrow \infty$ .

Figure 3 shows plausible conditions under which chronic specie scarcity, despite unrestricted specie-market arbitrage, can occur even when such is sub-optimal in terms of social welfare. Optimal individual actions lead to sub-optimal social outcomes (Davis 1964, v. 2, 77). These conditions were present in British North America during the late 17th and early eighteenth centuries. As such, chronic specie scarcity before any colony had issued its own paper currencies is plausible—an outcome produced by individual rational maximizing behavior.

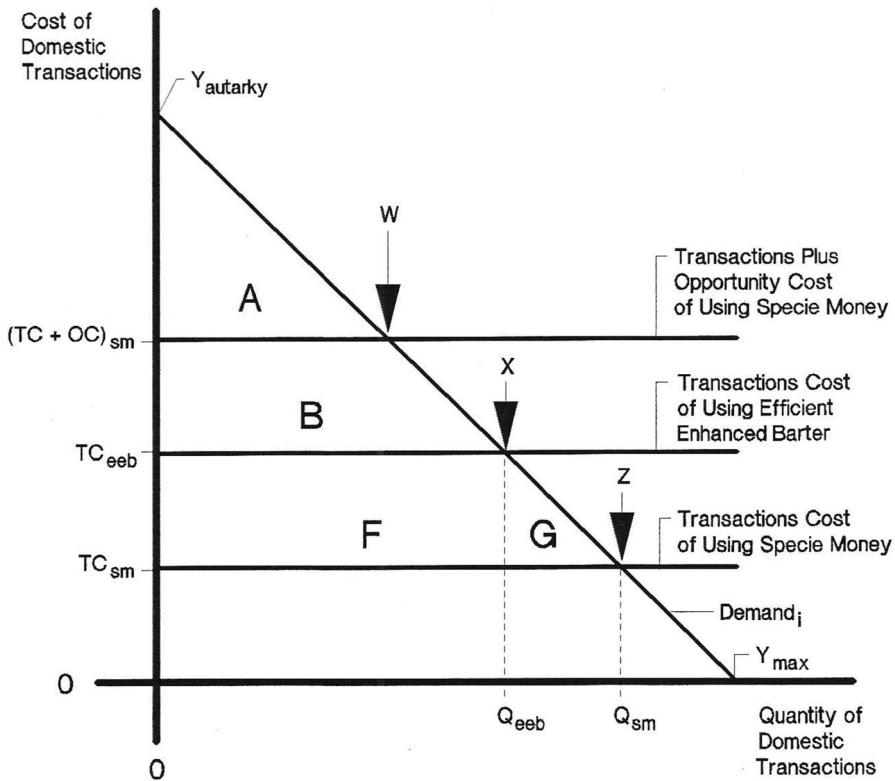
The sub-optimal welfare outcome in Fig. 3 can be ameliorated by policies such as banning specie exports, raising import tariffs, or encouraging import substitution so that  $OC_{sm}$  is reduced until area  $(B + C) > \text{area}(F + G)$ . Such policies could eliminate the incentive individuals have to export their specie money to purchase imported goods. Given that British regulations largely prohibited the colonies from imposing tariffs on British imports, banning specie exports, and systematically encouraging import substitution, some other colonial policy was needed to overcome the sub-optimal social welfare outcome in Fig. 3.

#### 4.4 Enhanced efficient ALME: Figure 4

Figure 4 modifies Fig. 3 by assuming that alternative local media-of-exchange (ALME) structures can be enhanced to create a broadly accepted way to clear transactions throughout the polity, called here enhanced efficient ALME (eeb). The use of enhanced efficient ALME for domestic exchange, given its transaction costs, may be sufficient to create a larger consumer surplus than the use of specie for that exchange, given specie' transaction *and* opportunity costs.

Figure 4 assumes that this enhancement is sufficiently large enough to cause  $(TC_{eeb} - TC_{sm}) \leq OC_{sm}$ . While the pure transaction costs of using specie money is always lower than the transaction costs of using ALME structures to execute domestic transactions, no matter how efficient the ALME structure, i.e.,  $TC_{sm} < TC_{eeb}$ , the full cost of using specie money to execute domestic transactions is now greater than the pure transaction costs of the enhanced efficient ALME structure for executing domestic transactions, i.e.,  $(TC + OC)_{sm} \geq TC_{eeb}$ . The transaction-cost gap is narrowed enough by enhanced efficient ALME structures to make the opportunity cost of not using specie money to purchase imported goods the dominant cost consideration for society. The failure to, as of yet, achieve significant import substitution via domestic production is an important prerequisite for attaining the outcome in Fig. 4.

Enhanced efficient ALME structures are accomplished by colonial legislatures creating their own inside paper monies, monies accepted throughout the polity but not outside that polity. Colonial paper money functioned as transaction-able debt instruments or bearer-bonds. They were anchored to future real values in the economy that could be claimed with that money. The most ubiquitous real-value anchors



**Fig. 4** Adding enhanced efficient ALME structures to the model. *Note* “Using Efficient Barter” in the Figure refers to efficient ALME structures, and “Using Efficient Enhanced Barter” in the Figure refers to enhanced efficient ALME structures, see text

were to the future specie-priced taxes levied by the colonial government issuing said money (Cutsail and Grubb 2021; Grubb 2016a, b, 2018, 2019b, 2024). The colonies created fixed exchange rates between the face value of their bills and specie, but only at specific future dates for designated amounts of bills outstanding to pay said taxes, as opposed to creating convertibility at a fixed exchange rate *on demand* between all bills and specie coins as was the case for nineteenth century banknotes. These anchors gave the money general acceptance within the issuing polity. This general acceptance was a step beyond efficient ALME structures which were confined to localized exchange networks organized around store book credits, shop notes, and common commodities that required repeat transactions and reputation development among networks of private store and commodity traders to sustain that ALME structure’s efficiency.

Figure 4 is similar to Figs. 1, 2, and 3 in that equilibrium point Z is to the right of point X with  $Q_{sm} > Q_{eeb}$ . The choice of the domestic transacting medium and the welfare outcome of this choice, however, differ. In Fig. 4, the cost assessment point for using specie money to execute domestic transactions, point W, is to the

left of that point for using ALME structures, point  $X$ , whereas in Figs. 1, 2, and 3 the reverse is true. This difference comes from the assumption in Fig. 4 that  $OC_{sm}$  exceeds the transaction-cost differential between using specie money and ALME structures for executing domestic transactions, a condition not present in Figs. 1, 2, and 3.

In Fig. 4, if Demander $_i$  uses his initial stock of specie money to execute domestic transactions, his consumer surplus is area  $A$ , i.e., area  $[(A+B+F+G) - (B+F+G)]$  because he has to subtract the opportunity cost of the foregone imported goods that the specie money could have purchased  $(B+F+G)$  from his net gain at point  $Z$ . Alternatively, if Demander $_i$  uses his specie money to buy imported goods and uses enhanced efficient ALME structures to execute domestic transactions, his consumer surplus is area  $(A+2B+F+G)$ , i.e., the gain from having the imported goods  $(B+F+G)$  plus the gain from using ALME structures to trade for domestic goods  $(A+B)$ . Given the assumption in Fig. 4 that  $OC_{sm} \geq (TC_{eeb} - TC_{sm})$ , the area  $(A+2B+F+G)$  is always greater than the area  $A$ . Therefore, Demander $_i$  comes out ahead by using his specie money to buy imported goods and using enhanced efficient ALME structures to execute domestic transactions. The outcome for Demander $_i$  in Fig. 4 is the same as in Fig. 3. In both cases, Demander $_i$  has a personal welfare maximizing incentive to export his initial stock of specie money rather than use it to execute domestic transactions. The only difference for Demander $_i$  is that his welfare gain is larger in Fig. 4 than in Fig. 3. In both cases, chronic specie scarcity for executing domestic transactions is the result.

While immediately exporting one's specie money to buy imported goods is the optimal behavior for each individual in both Figs. 3 and 4, it is not the welfare maximizing outcome for society as  $n \rightarrow \infty$  in Fig. 3 but is the welfare maximizing outcome for society as  $n \rightarrow \infty$  in Fig. 4. This is the key difference between Figs. 3 and 4, between efficient and enhanced efficient ALME structures. Figure 4 eliminates the sub-optimal social welfare outcome in Fig. 3. The development of enhanced efficient ALME structures in Fig. 4 aligns individual welfare maximizing behavior with social welfare maximizing outcomes.

In Fig. 4, if Demander $_i$  follows his individual welfare maximizing choice and exports his specie money to acquire imported goods, then this specie money is no longer available for Demanders $_{j \text{ through } n}$  to use for executing domestic transactions. Each individual who has an initial stock of specie money faces this situation. Demander $_i$  receives area  $(A+2B+F+G)$  from this choice, and Demanders $_{j \text{ through } n}$  can only use enhanced efficient ALME structures to execute domestic transactions, with each receiving area  $(A+B)$  only. Thus, the total social welfare for all demanders in this polity will be area  $(A+2B+F+G)$  for Demander $_i$  and area  $(n-1)(A+B)$  for the rest of society, i.e., for Demanders $_{j \text{ through } n}$ . Total social welfare under this outcome is area  $[nA+nB+(B+F+G)]$ .

By contrast, suppose each demander goes against his individual welfare maximizing choice and uses his specie money to execute domestic transactions, foregoing the purchase of imported goods with that specie money. Because specie coins are continuously passed from one demander to the next, it circulates throughout the polity executing all domestic transactions. As such, each demander receives a welfare

gain of area  $A$ . Because each demander in society gets this individual welfare, total social welfare is area  $n(A)$ .

Comparing the two outcomes, for any  $n$ , even  $n \rightarrow \infty$ , social welfare is maximized by not retaining specie money to execute domestic transactions, i.e.,  $nA < [nA + nB + (B + F + G)]$ . The one-off benefit to the initial demander of exporting his specie money ( $B + F + G$ ) always exceeds the subsequent foregone net benefit to all subsequent demanders of not having that specie money for executing their domestic transactions. The opportunity cost of using specie money to buy imported goods dominates the welfare assessment both for the individual and for society. Figure 4 shows plausible conditions under which chronic specie scarcity, despite unrestricted specie-market arbitrage, can occur and be welfare enhancing for the polity.

#### 4.5 Evolution of colonial regimes

The British North American colonies can be characterized as evolving from Figs. 2, 3, 4. Early on, colonial societies developed efficient ALME structures. This induced chronic specie scarcity that was socially sub-optimal. To eliminate this sub-optimal welfare outcome, colonies created viable inside paper monies that allowed them to capture the value of the imported goods that only specie money could buy while also being able to efficiently execute domestic transactions.

The evolution from efficient to enhanced efficient ALME structures did not eliminate chronic specie scarcity, but it did ameliorate the sub-optimal welfare outcome that efficient ALME structures caused and so may have encouraged domestic economic development.<sup>22</sup> The incentive to move from Figs. 3, 4 increases as a colony's population increases, because the social welfare loss in Fig. 3 increases with population growth, and population growth itself will not overcome the sub-optimal social welfare outcome in Fig. 3. As colonies grew, they systematically moved from a Figs. 3, 4 regime.

## 5 Conclusions

North American colonists claimed that gold and silver coins were chronically scarce for executing domestic transactions and paying local taxes despite unrestricted trade in specie. Chronic specie scarcity was not caused by currency substitution between paper and specie monies. It was caused by the prior development of locally efficient non-specie media-of-exchange structures. This led welfare maximizing individuals to export all their specie money causing a socially sub-optimal welfare outcome in domestic transactions. Subsequent creations of inside paper monies by colonial

<sup>22</sup> The move to enhanced efficient barter was delayed in colonies with the most efficient commodity barter systems, namely Maryland and Virginia. These colonies used tobacco as a medium of exchange and unit of account in domestic transactions in an organized colony-wide way. The welfare gains from moving from efficient barter (tobacco money) to enhanced efficient barter (colony-issued paper money) were not as great for these colonies. Therefore, it is not surprising that Maryland and Virginia were two of the last colonies to initiate inside paper money systems. See Hening (1819, 6: 568–69), Grubb (2016a, 2018, 2019a, b, 2020, 2024).

governments mitigated the socially sub-optimal welfare outcome of this efficient media-of-exchange induced chronic specie scarcity. The model of chronic specie scarcity developed here is also consistent with, and makes sense of, contemporary colonial commentators who saw the lack of import substitution as contributing to specie scarcity.<sup>23</sup> These commentators considered policies that encouraged import substitution as a potential solution to chronic specie scarcity.

The driving force behind the evolution of monetary transaction regimes modeled here is the relative size of the opportunity cost of using specie money to execute domestic transactions, namely the foregone imports that only specie money could purchase, compared with the transaction-cost gap between using that specie money versus the next best inside localized media-of-exchange structure for executing domestic transactions. As this opportunity cost goes to zero via domestic economic development yielding import substitution, namely as domestic goods and imports become perfect substitutes (as  $OC_{sm} \rightarrow 0$ ), chronic specie scarcity disappears. Given that the outside money (specie) is transaction-cost superior in all trades, the outside money will be retained for use in future domestic transactions given that imported goods have no superiority over domestic good substitutes. As such, chronic specie scarcity is more prevalent in small underdeveloped export-driven economies with limited domestic production sectors.

The transaction-cost model developed here points toward what should be the empirical focus for future research into colonial internal economic development and the role monetary choices played in that development. Charting the changing conditions that fostered import substitution, or the changes that altered the elasticity of substitution between imports and domestically produced goods, is a key item that needs further investigation and measurement. The relative transaction costs connected with alternative methods of executing domestic trades are the other key item that needs further investigation and measurement. In tandem, the changing size of the positive opportunity cost to using specie to buy local goods rather than imported goods in relation to the changing size of the transaction costs to using alternative media of exchange to execute local trades compared with using specie coins is the key determinant for measuring how monetary choices influenced a colony's internal economic developed.

**Acknowledgements** Preliminary versions were presented at the Third European Congress on World and Global History, London School of Economics, London, UK, 14–17 April 2011; The Institute for Global Law and Policy Pro-Seminar on Re-Theorizing Liquidity, Harvard Law School, Cambridge, MA, 6–9 June 2011 and 2 June 2012; the Conference on “De-Teleologising History of Money and Its Theory,” Japan Society for the Promotion of Science Research—Project 22330102, University of Tokyo, 14–16 February 2012; University of Delaware, 11 October 2012; Allied Social Science Associations Annual Conference, San Diego, 5 January 2013; and the conference on “Money as a Democratic Medium,” Harvard Law School, Cambridge, MA, 14–15 December 2018; Conference on “Money in Vast Early America,” sponsored by the University of Southern California, the Huntington Early Modern Studies Institute, and the *William and Mary Quarterly* held at the Huntington Library, Pasadena, CA, 9 Dec. 2023. The author thanks the participants of these conferences and Christine Desan, Alejandro Komai, Akinobu

<sup>23</sup> See Brock (1975: 1, 230, 240–41, 523, 561–62), Davis (1964, 1: 177, 233–34, 357–61, 378, 388, 402, 430; 2: 14–15, 40, 50–51, 155, 282–83, 369, 401, 434; 4: 33, 62, 93), Fisher (1911: 294–95), Labaree et al. (1969, 13: 467; 1970, 14: 38, 232, 1972, 16: 2), Lester (1938: 329; 1939: 210, 212), Nettels (1934: 8–9, 46–47, 67–68, 98, 137–41, 151, 158, 280–83).

Kuroda, and Angela Redish for helpful comments. This article honors the influence of Douglass C. North whose graduate courses in economic history and property rights I took in the mid-1970s.

## Declarations

**Conflict of interest** The author has no relevant financial or non-financial interests to disclose nor any competing interests to declare that are relevant to the contents of this article.

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