The Urban Process Under Distinct Accumulation Regimes:

A Research Strategy

MARSHALL M. A. FELDMAN

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Center for Urban Studies and Research and

The Charles T. Schmidt, Jr. Labor Research Center

The University of Rhode Island

36 Upper College Road

Kingston, RI 02881

USA

t: 01.874.5953

f: 01.874.2954

e: marsh@uri.edu

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Abstract

This paper demonstrates a research strategy for the theoretical investigation of capitalist crises. It draws upon a particular technique (computer simulation), complementary theoretical approaches (regulation, monetary and capital circuits, and capital switching in the urban process), and multiple disciplines (economics, geography, and urban studies). It starts with David Harvey's classic theory of capital switching to the built environment as a temporary spatial fix to crises. Although this theory has been very influential, it has limitations in its attention to detail, its treatment of money, and its failure to allow for modes of regulation underpinning distinct accumulation regimes. The paper addresses these issues by using computer simulation to integrate regulation theory and monetary circuit theory with Harvey's theory. Instead of a general "urban process under capitalism," the study develops simulation models calibrated to (1) Fordism and (2) financialized neoliberalism. By contrasting their results, the paper demonstrates the strategy's viability and the value of combining the approaches.

Key Words: accumulation regime crises, capital switching, computer simulation, monetary circuit, urbanization

Résumé

Cet article illustre une stratégie de recherche pour l'étude théorique des crises capitalistes. Elle se fonde sur une technique particulière (simulation par ordinateur), les approches théoriques complémentaires (règlement, circuit monétaire et le capital de commutation dans le processus urbain) et plusieurs disciplines (économie, géographie et études urbaines). Il commence par la théorie classique de David Harvey de commutation capital dans l'environnement bâti comme un repère spatial temporaire aux crises. Bien que cette théorie ait été très influent, il a des limites dans son attention aux détails, son traitement de l'argent et son incapacité à prévoir des modes de régulation qui sous-tendent les régimes d'accumulation distincts. Cet article aborde ces problèmes en utilisant une simulation sur ordinateur pour intégrer la théorie de règlement et de la théorie du circuit monétaire avec la théorie de Harvey. Au lieu d'un général "processus urbain sous le capitalisme", l'étude développe des modèles de simulation calibrés au (1) fordisme et (2) le néolibéralisme financiarisée. En comparant leurs résultats, cet article démontre la viabilité de la stratégie et la valeur de combiner les approches.

Mots clés : crises de régime d'accumulation, la commutation capitale, simulation d'ordinateur, circuit monétaire, l'urbanisation

> Overaccumulation within the secondary and tertiary circuits often acts as a trigger for more general crises. The importance of this is all too often neglected in general accounts of the dynamics of capital accumulation ... the most important prop to the US and British economies after the onset of the general recession in all other sectors from mid-2001 onwards was the continued speculative vigour in the property and housing markets and construction. ... What happens if and when this property bubble bursts is a matter for serious concern.
>
> Harvey (2005, 112-113)

1 The Urban Process and the Circuit of Capital

David Harvey's theory of capital switching and the urban process is based on Marx's political-economic writing, especially Volume II of *Capital*. Harvey starts with Marx's famous diagram of the circulation capital presented early in Volume II

$$M - C\{MP, LP\} \ldots (P) \ldots C' - M'$$

because it has potent geographical implications and seeks to uncover "any underlying unity" and contradictions contained within the circulation of capital (Harvey 2006b, 405). This is partly, but only partly, because the metamorphosis from one form of capital to another often requires spatial proximity. Moreover, space and time are intimately linked, with space presenting a barrier to capital, adding to its turnover time, and decreasing the rate of profit.[1] Various features of developed capitalism, such as the credit system, can relax such constraints and allow capitalism's spatial scale to expand. But the means of circulation, particularly physical and social infrastructure, have even stronger implications. Generally they are themselves forms of capital and are therefore their circulation and metamorphoses resemble those of other forms of capital, but they differ in important ways. Infrastructure is generally spatially fixed and involves exceptionally large amounts of capital, and because its turnover time is typically much longer than that of most ordinary commodity capital, the applicable time-span for infrastructure is much longer, and is likely to involve more complex and varied paths of circulation.

But physical (urban) infrastructure is not the only form capital take that does not conform to the circuit Marx investigated extensively in Volumes II and III. Harvey mentions fixed capital, the consumption fund (long-lived items of consumption), science and technology, administration (generally by the state), and (repressive and productivity-enhancing) social infrastructures (also generally located within or related to the state). Capital flows through all these different forms, and the flows themselves can be coordinated by a standardized interest rate. But since the latter constitutes a web of "fictional relationships," "real value creation" depends actual flows of value through these circuits and on their overall mutual articulation, with each flow having its own temporal rhythms and requirements and distinct spatialities(Harvey 2006b, 407-8). Figure 1 is Harvey's summary of the paths these flows of value follow.

[1] "Capital by its nature drives beyond every spatial barrier. Thus the creation of the physical conditions of exchange – of the means of communication and transport – the annihilation of space by time – becomes extraordinarily necessary for it" (Marx 1993, Notebook V).

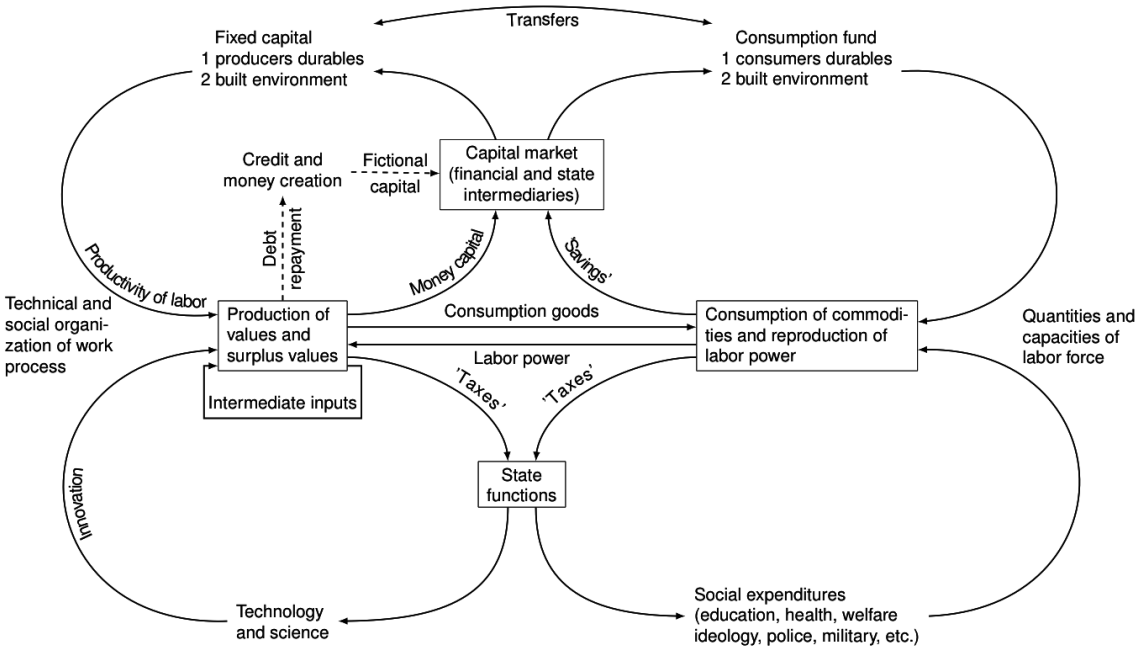

Figure 1: The paths of capital flow. *Source:* Harvey (2006b, 208).

The spatial properties of these flows vary, and different kinds of flows have different mobilities. Harvey's analysis is a bit functionalist in that shifts among the flows in the system allows capitalism to adapt "to the task of shaping spatial organization and flows to long-run aggregative requirements" (Harvey 2006a, 407). Also note that he assumes a degree of "conservation of value," or "exogenous money," in that credit depends on prior savings and accumulation of capital. Thus for infrastructure to receive capital:

> There must be surplus capital and a form of organization – usually the state ... – capable of centralizing the surplus capital, putting it into the creation of certain use values, and waiting several years before reaping any reward. This also implies a conscious recognition and anticipation of capitalism's future needs (Harvey 2006b, 409).

Harvey divides the circuits in Figure 1 into three groups. Organized vertically, the "primary circuit" consists of the middle part involving production of values and surplus values and their consumption. Here Harvey claims he follows Marx by tacitly assuming production and consumption occurs within one time period (Harvey 1978, 104). The top of the figure represents the "secondary circuit" and involves the built environment as well as producer and consumer durables. Finally, the bottom represents the "tertiary circuit" of capital, which has two components. On the production side, it includes investments in science and technology, which can increase productivity in production through technological advance or open up new venues for capital accumulation by the creation of new products. On the consumption side, social

expenditures either improve the quality of labor power for capital ("human capital") or control it.

The secondary circuit is most important here.[2] Although Harvey lumps four distinct categories together in the secondary circuit, they differ substantially (Table 1). Producer and consumer durables are both generally produced under capitalist conditions and sold as commodities, but otherwise they differ substantially. Through depreciation, the value of producer durables, such as tools and machines, enter into the value of other commodities in whose production processes the durables are used. Because they enhance the productivity of labor, technological innovation can devalue existing producer durables. If computer numerical control (CNC) technology renders an ordinary cutting machine obsolete, capitalist enterprises owning the old machines must either upgrade their technology or find themselves at a severe competitive disadvantage. On the supply side, producers of consumer durables innovate to gain advantage over competitors, while on the demand side, competition among buyers of consumer durables drives their demand for such durables. Such innovation can devalue existing producer durables, and partly because of this, there are substantial lease/rental markets for producer durables. Nonetheless, if a firm can purchase a devalued, used producer durable at low cost, is willing and able to accept lower profits, or operates in markets where competitors are unlikely to implement new technologies for reasons of cost, supporting infrastructure, availablility of skilled labor, etc., purchasing used and depreciated producer durables may be a viable option. For this reason many producer durables have robust second-hand markets, particularly when they may be shipped from an advanced capitalist region and used in a less developed one. But despite this, only in exceptional circumstances are used, depreciated producer durables subject to investment as speculative assets.

In contrast, the value of consumer durables does not directly affect the value of other commodities and may affect them only indirectly, by influencing the value of labor power. Even so, unless wage rates are set at some necessary subsistance level, so that wages reflect the cost of reproducing labor power, changes in the value of consumer durables will not affect the value of other commodities. Similarly, innovations in consumer durables that reduce the labor time needed to reproduce labor power have no direct impact on labor productivity and only translates into greater surplus value if they affect the price of labor power or makes labor available for longer working hours (absolute surplus value). Technological and social innovation in such durables may affect their price and the demand for them, but usually innovation does not devalue them. A consumer who does not upgrade an obsolete heating boiler or television may experience extra cost or inconvenience, but failure to upgrade does not threaten the consumer's continued social existence. Moreover, on the supply side, inter-capitalist competition in consumer durables may drive innovation as producers seek greater market share, lower costs, etc., but it does not drive innovation on the demand side. With the exception of conspicuous consumption and "keeping up with the Joneses," consumers do not compete with each other, and therefore competition among consumers does not pressure them to demand new technologies in durable goods. So while there are second-

[2] Throughout this discussion I assume contemporary institutions and forms present in the advanced capitalist countries, particularly the United States. While particulars may be different in other settings, *mutatis mutandis* many of the same general points apply.

Table 1: Components of the secondary circuit and their characteristics

	Fixed Capital		Mixed	Consumption Fund	
Characteristic	Producer Durables	Built Environment	Infrastructure	Built Environment	Consumer Durables
Produced and sold as commodities	Yes	Partially	Sometimes	Partially	Yes
Value enters into the value of other commodities	Yes	Partially	Generally not	No	No
Affects productivity (of labor)	Yes	Partially	Partially	No	No
Can be devalued by competing innovations	Yes	Partially	Yes	Indirectly	No
Inter-capitalist competition drives demand for innovation	Yes	Partially	Partially	No	No
Substantial rental markets	Yes	Yes	No	Yes	No
Robust second-hand markets	Yes	Yes	No	Yes	No
Location affects value embodied in price	No	Yes	Sometimes	Yes	No
Involves ground rent	No	Yes	As an effect	Yes	No

hand markets for older, obsolete consumer durables, such markets are typically local and insubstantial. One possible exception is automobiles: second-hand markets for autos are indeed robust, and leasing instead of outright ownership is common. Thus, producer durables are assets that may have substantial salvage values and can even be subject to speculation, but except in rare instances – e.g., luxury items such as Ferraris or works of fine art – consumer durables are primarily use values with little value in second-hand markets.

The built environment presents a very different story for both production and consumption, and one must treat collective infrastructure separately from individually purchased commodities. Harvey devotes considerable attention to infrastructure, partly because so much of it is inherently geographical. Not only transportation infrastructure, such as roads, airports, and seaports, but also utility infrastructures, such as electric power grids, sewer systems, and gas

pipelines, are primarily concerned with moving and coordinating geographical flows. This intimate relation to territory and the huge investments required at this scale partly explain why the state commonly produces, owns, and/or regulates infrastructure. Even when privately provided, state-regulated infrastructure is often a spatial monopoly with regulated prices set outside the market, so its provision deviates from the capitalist processes Harvey describes for the primary circuit. Some state-owned infrastructure is provided as a public good, and as such enters into the cost structure of other commodities only through taxes. The cost of other infrastructure, state-provided and otherwise, is at least in part paid for through user fees, and therefore these costs enter into the ledgers of private capital on two lines. Furthermore, individual items of infrastructure are commonly used for both production and consumption. The electric grid, for example, lights homes, factories, and offices. Hence, infrastructure is only partially produced and sold as a commodity, and its value only partially is transmitted to other, "ordinary" commidities in the primary circuit.

When workers use collective infrastructure, its characteristics can add to their productivity. A good example is workers transporting materials or partially finished goods from a warehouse to a factory over public roads: the quality of the road infrastructure will influence the required transportation time. So in this sense, infrastructure can affect productivity. Because infrastructure is not capitalistically provided in the usual sense, it is generally not devalued by innovations, nor does inter-capitalist competition drive innovation. However, insofar as infrastructure is spatially fixed within specific territories, competition between regions may provide motivation for innovation and technological change.

Privately held components of the built environment, such as buildings and developed land, constitute the remainder of the secondary circuit, but there are important differences between the producer (commercial real estate) and consumer (residental real estate) parts. Commercial real estate is produced and sold as a commodity, although much of it is also rented out. Through depreciation, its value contributes to that of commodities produced within its confines, and commercial real estate's layout and physical plant affect productivity, and for this reason competing organizational and technological innovations can cause devaluation of commercial real estate.[3].[3]Inter-capitalist competion drives the demand for innovation – among both suppliers of commercial real estate and users: to stay competitive, a manufacturer whose factory lacks computer network wiring may either have to install adequate wiring or move to a new factory. So competition in industries *occupying* commercial real estate can drive demand for innovation. Because buildings are long-lived and often occupy desired locations, markets for existing commercial real estate are common, well organized, and robust. As with all real estate, location is a major determinant of market value – both because a given location may offer costs or benefits to a specific occupant and because other nearby uses can drive up the price of occupancy and complement or diminish the (use) value of a site to a particular occupant. And of course, (differential, absolute, and monopoly) ground rent is a major component of market value.

Residential real estate is mainly bought and sold as a commodity in the U.S., but elsewhere and even in the U.S. the state provides some "public" housing. Furthermore, public subsidies through tax and other benefits for privately

[3]The advantages of sprawling single-story factories over multi-story buildings with elevators is perhaps the most well-known example.

owned housing are substantial, so even privately owned housing does not completely conform to the standard template of capitalist production as in the primary sector. Although characteristics of residential real estate might affect labor productivity through sanitation, noise, crowding, etc., in general it seems housing affects labor productivity very little. Because housing is used almost exclusively for consumption, no competitive discipline forces technological upgrading on the owners of residential property. Nonetheless, technological and other innovations may alter the market value of residential real estate, as when widespread adoption of the automobile devalued houses without garages or when the Internet and telecommuting altered property values in different locations. As is the case with commercial real estate, residential real estate also has substantial rental markets and robust markets for existing properties, location greatly affects the market value of residential properties, and all forms of ground rent play a crucial role in residential real estate markets.

Because of this diversity, treating producer and consumer durables, infrastructure, and residential and commercial real estate as a single, homogenous "secondary circuit" is inappropriate. For the purposes of this paper, I include some and exclude other components of Harvey's secondary circuit, and I distinguish among those I include.

2 Circuits of Capital

The primary circuit

Exactly what distinguishes Harvey's "primary circuit" is unclear. After briefly summarizing Marx's analysis of capitalist exploitation and accumulation in Volume I of *Capital* and of the circulation of capital in Volume II, Harvey depicts the relationships Marx investigates (Figure 2). Harvey then implies that the distinguishing feature of the primary circuit is its turnover time Harvey (1978, 104, original emphasis): "In both cases Marx assumes, tacitly, that all commodities are produced and consumed within one time period. The structure of relations examined ... can be characterized as the *primary circuit of capital*." Two pages later, he begins his discussion of the secondary circuit by saying, "We now drop the tacit assumption of production and consumption within one time period and consider the problems posed by production and *use* of commodities requiring different working periods, circulation periods, and the like" Harvey (1978, 106, emphasis added).

This characterization of Marx's analysis is not quite accurate. Chapter 4 of Volume II briefly analyzes turnover time, Chapter 5 is devoted to the time of circulation, and the entire second part of Volume II is devoted to analyzing "the turnover of capital." More importantly, turnover is too complex to characterize a large segment of any capitalist economy as having a single, fixed circulation time equal to one period or fixed multiples thereof.

Harvey's distinction between primary and secondary circuits hinges on an "assumption," and therefore is an analytical-epistemological device. But Figure 1 suggests the two circuits are actual paths through which capital flows and therefore that they have ontic status. Also note that producer and consumer durables, built structures in commercial and residential

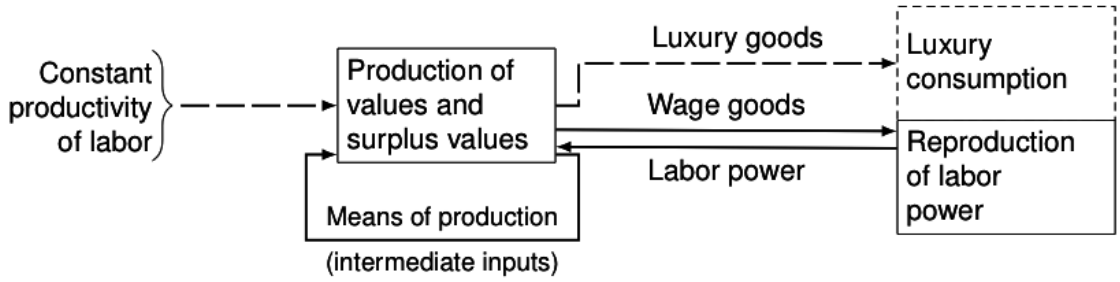

Figure 2: Relationships in "Reproduction on and Expanded Scale" (in the primary circuit). *Source:* Harvey (1978, 105).

real estate, and much infrastructure are produced and sold as commondities embodying value and surplus value, so in this sense the primary and secondary circuits are alike. Furthemore, components of the secondary circuit under the heading of "fixed capital" serve as means of production, while those under the heading of the "consumption fund" serve as means of consumption. Harvey also explicitly includes time of *use* within the scope of the turnover time that distinguishes the two circuits. But for Marx (1967c, 153), "the entire time of circulation of a given capital is equal to the sum of its time of circulation and its time of production. It is the period of time from the moment of the advance of capital-value in a definite form to the return of the functioning capital-value in the same form." So on one hand, the time of consumption of items in the consumption fund – an automobile or a house, for example – is irrelevant to the turnover time of capital if the capitalist has been paid and capital has returned to its original form as money capital, ripe for reinvestment. The consumer may have expended savings or may be repaying debt, but according to Marx, capital has completed at least one circuit. On the other hand, the money capital of a capitalist who purchases a producer durable or a factory is indeed tied up until the capitalist realizes enough value to replace the original outlay. But this is a transfer of value from the capitalist purchaser to the capitalist producer, with the latter's capital returning to its orignal form and the former's being tied up for many time periods. There is some irony here in that there is no obvious reason to differentiate capitalists who purchase fixed capital to produce more fixed capital and items in the consumption fund (e.g., automobiles and trucks) from those who purchase fixed capital to produce short-lived consumer goods (e.g., bathroom tissue)! Both have their capital tied up for long time periods, but this depends on the production processes in the two firms rather than the time it takes to consume their products. (E.g., a bathroom-tissue factory may employ more fixed capital over longer periods than an automobile factory does.)

Furthermore, not only does the time of use weigh upon the buyer rather than the seller, turnover time also is not and can not be constant. During economic downturns finished inventory stays on the shelf, so the time of circulation increases; during downturns producers also cut back production, extending the time during which capital is tied up not only in fixed capital (idle means of production), but also in supplies held as inventory (constant capital), hoards of money

capital (financial capital), and unsold finished product (commercial capital).

This reliance on use value is also reflected in the complete absence of money in Harvey's primary circuit. Of course he is aware of the important role of money throughout capitalism, but this conception of the primary circuit makes no explicit mention of money in the circuit. Indeed, Figure 2 could easily depict a pure barter economy.

So as presented, the distinction between the two circuits based on the turnover time of capital is a rather chaotic conception. In other words, a theory of capital switching between circuits of capital requires a more rigorous theorization of the circuits themselves.

Duncan Foley's formal mathematical models of the circuit of capital can help sort this out. Early versions addressed long-standing issues in Marxian political economy, such as realization problems and accumulation (Foley 2014), and the relation between turnover time and the rate of profit (Foley 1986). These versions resemble Harvey's analysis in that they assume the various time lags in the circuit are fixed and exogeneously given. More recent versions (Foley 2013) use behavioral equations to model expenditure decisions, modifying the time lags and making them endogenous to the model. Rugitsky (2014) builds on this model, calibrates most of its parameters empirically, and applies it to the housing bubble leading up to the Great Recession. This body of work is therefore quite apropos for a rigorous examination of Harvey's switching thesis. The basic model is very much along the lines of Harvey's primary circuit, so it is a useful starting point.

2.2 Foley's Approach

Both Foley and Harvey base their analyses on a close reading of Marx, particularly Volume II of *Capital*. Nonetheless, important conceptual issues distinguish the two.

Harvey's emphasizes a *quid-pro-quo*, with labor power exchanging for wage goods (Figure 2). Although "production of values and surplus values" occupy a central place in Harvey's diagram, "value" disappears in the rest of the diagram. The components of final output – luxury and wage goods – are *use values*, as are newly produced means of production (intermediate inputs).

Foley's (1986) circuit of capital, on the other hand, emphasizes value and follows Marx more closely by explicitly considering the metamorphosis of value (Figure 3). Following the same sequence as in Marx's diagram, at any given time, t, capitalists use a portion of the stock of financial (money) capital, $F(t)$, to purchase means of production and labor power.[4] These capital outlays are a flow of value between finance and production. If $Z(t)$ represents the total of these capital outlays and the composition of capital, κ, represents the proportion spent on labor, then $\kappa Z(t)$ is the amount spent on direct labor inputs (variable capital) and $(1-\kappa)Z(t)$ is the amount spent on materials and means of production (constant capital). At the next node, the circulation process is interrupted while value is tied up in production as a stock of

[4] Foley substitutes "financial capital" for Marx's references to "money capital." This reflects differences in capitalism in their days: savings of commodity money, bank deposits, and bank notes were most important in the mid-nineteenth century, and hoards of various forms of fiat and credit money as deposits or not, bank credit, and financialization were most important in the late-twentieth. Santos (2013) provides a useful account of the logic of this evolution.

productive capital, $N(t)$, which takes the form of inventories (of raw materials, purchased inputs, and unfinished product) and as plant and equipment. Value passes to the finished product, $P(t)$, as the (labor) value added in production, the value contained in purchased inputs used in the finished product, and the value of depreciation of plant and equipment passed on to the finished product. This flow of value adds to the stock of commercial capital, $X(t)$, as an inventory of products awaiting sale.[5] When these are sold, the commercial capital is converted back into money as an amount equal to total sales, $S(t)$. It is useful to break this flow into two parts: (1) an amount of value equal to the amount originally advanced at the start of the circuit and (2) the excess over the original amount, in other words, the surplus value created in the process. Call the first part $S'(t)$ and the second, $S''(t)$. Let the *capitalization rate*, p, be the proportion of the surplus value thrown back into the circuit and accumulated, so that the amount accumulated is $pS''(t)$. The remainder of the surplus value, $(1-p)S''(t)$, is siphoned off and used for other things, such as capitalist consumption, unproductive labor, and the State.[6].[6]

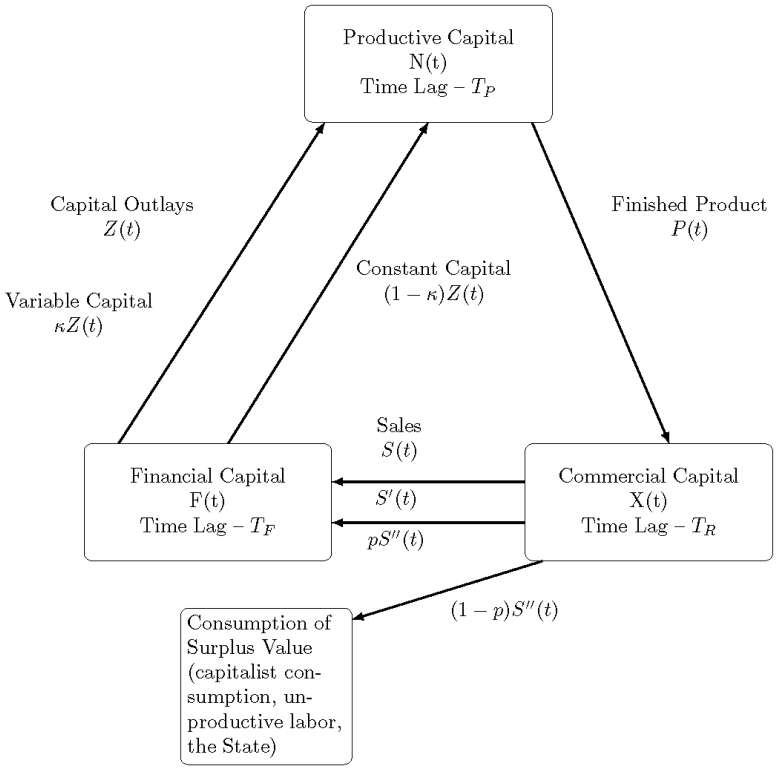

Figure 3: Foley's circuit of capital. *Source:* Foley (1986, 67).

Marx (1967c, 23)refers to the circulation process being "interrupted" when capital is not in motion. Foley addreses

[5] Marx refers to this as "commodity capital."
[6] Later on Foley (1986, 106) adds rent to the list.

this by introducing time lags into the model. The time between the expenditure of capital outlays to purchase of means of production and labor power and when the finished product emerges to become commercial capital is *the production lag*, T_P. The time the finished product sits as inventories without being sold is *the realization lag*, T_R. And the time that financial capital sits idle is the *finance lag*, T_F. Each one is the turnover time of its respective phase of the circuit of capital, and the total turnover time is equal to their sum, $T_P+T_R+T_F$. By introducing these lags and treating them as simple time delays, Foley is able to account for each flow in terms of others. For example, the finished product emerging at time *t* must equal capital outlays at time *t* - T_P

$$P(t) = Z(t - T_P).$$

In this approach, surplus value enters the picture when product is finally sold. Let *q* be the markup on costs, then the value of sales at time *t* is given by

$$S(t) = (1+q)P(t - T_R) = S'(t) + S''(t).$$

In Marxian theory, the markup is $q = \varepsilon\kappa$, where ε, the rate of exploitation (surplus value), equals the ratio of surplus value to the value of wages. By this definition, $\varepsilon = qP(t - T_R) / \kappa Z(t - T_R - T_P)$. From (2) this becomes $\varepsilon = qZ(t - T_P - T_R) / \kappa Z(t - T_R - T_P) = \frac{q}{\kappa}$. Note, however, that here q is the markup on the current value of product cost, which reflects capital advanced $T_P + T_R$ periods earlier. If turnover times, composition of capital, or markup change, the so too will the rate of exploitation.

Notice several important features of this approach. First, it based on "Stock-Flow Consistent" (SFC) models (Lavoie and Godley 2012). As such, they are coherent, in the sense that they treat stocks as stocks and flows as flows, and internally consistent, in the sense that they account for all value in the system. A related feature is that the stocks in the model correspond to assets on balance sheets of firms and the flows correspond to income and expenditures on firms' income statements.

Second, although finished product originates in the production phase and flows into the stock of commercial capital, in this specific model firms are vertically integrated. Producers do not sell to wholesalers or retailers who then hold commercial capital as inventory. If this were not the case, then these resellers would pay producers, and a portion of the total capital would return to the money form before final sales, realization would occur in two steps (as sale of producer's finished product inventory and as wholesale and retail sales), and surplus value would take the form of both producer and merchant profits. Similarly, this particular application of the approach has no separate banking sector, and interest payments are absent, as is credit. More elaborate models using this approach incorporate these missing elements.

Third, a less obvious point is that Foley's approach to the circuit of capital interprets the labor theory of value the same was as the "new approach" to the transformation problem (Foley 2014). The latter defines the value of money as the ratio between the total productive labor performed and the price of the net product, so that the value of money is measured in

units of time per unit of currency. The value of labor power then becomes the value of money times the wage rate, so the value of labor power is a pure number less than one, with surplus value equal to one minus the value of labor power (Saad-Filho 1996). Since the value of money now corresponds to a specific amount of labor time per unit of currency, all value in the circuit of capital can be measured in monetary terms and converted into labor hours simply by multiplying money amounts by the value of money. Here the value of money is neither the labor time needed to produce a unit of commodity money such as gold, nor is a function of the total money supply. This interpretation effectively dismisses "old" interpretations of the transformation problem as misunderstandings of Marx's labor theory of value that treat value and price systems as independent rather than as one and the same thing analyzed at different levels of abstraction. Unlike traditional solutions to the transformation problem, this interpretation does not need to assume equilibrium, simple reproduction, or equalization of profit rates across the economy (Saad-Filho 1996).

Harvey, developed his theory while the new approach was in its infancy. Consequently he neither considered it nor drew upon it (see esp. Harvey 2006b, 61-8), confronted with the complexity of contemporary capitalist economies, he deliberately moves away from the labor theory of value in his theory of capital switching (Harvey 1978, 110-111). He justifies this by referring to the diversity of forms of surplus value, inequality of profit rates, the integral role of interest in the built environment, the role of the state in the secondary and tertiary sectors, unconventional pricing of the built environment, and the irrelevance of the rate of profit for understanding capitalist behavior as a class. He claims "the rate of profit ... is perfectly appropriate for understanding the behaviours of individual capitalists in competition, but cannot be translated into a concept suitable for examining the behaviour of capitalists as a class without some major assumptions (treating the total profit as equal to the total surplus value, for example)." He therefore employs a concept of "productivity of investment" rather than "profitability" as a way to "by-pass some of these problems" and defines "a productive investment as one which directly of indirectly expands the basis for the production of surplus value" [but which itself implicitly need not be profitable] (Harvey 1978, 110). While perhaps adding some useful ways to think about some kinds of capitalist economic activity, this seems to throw the baby out with the bathwater. Compare Harvey's statement with this one: "Marx was adamant that these [Marx's aggregate] equalities are not independent conditions, but one and the same; the reason why total prices equal total values is that total profit equals total surplus value" (Saad-Filho 1996, 9). In Harvey's model, what is the point of expanding the production of surplus value if the complexities of contemporary capitalism not only completely hide surplus value from view but also fragment it, weaken its dynamics, and replaces them so much that it becomes largely irrelevant both to capitalists intent on gaining wealth and power and to critical scholars intent on understanding capitalism? Foley's approach to the circuit of capital, including its use of the new interpretation of the labor theory of value, obliterates many of the problems Harvey ran into, and by doing so may in fact save the baby.

2.3 Towards a Synthesis

Harvey builds on Marx's analysis of the circuit of capital and proposes an extension dividing the circuit into two parts, a *primary circuit* of relatively short-lived commodities and with relatively short turnover times and a *secondary circuit* consisting primarily of consumer durables, fixed capital, and the built environment, all of which allegedly share the characteristics of exceptionally long economic lives, long times of consumption, and long turnover times. He further proposes that capitalist competition invariably leads to *overaccumultion* in the primary circuit, which potentially can precipitate crises. In such circumstances, a *switch of capital investment to the other circuits* can temporarily forestall crises. This switch transforms but does not eliminate the tendency toward overaccumulation, reproducing it in the other circuits. Insofar as the built environment constitutes a major part of the secondary circuit, it has the potential to transform the overall pattern of capital accumulation by opening geographical regions and by transforming the entire space economy of the existing regime of accumulation.

While remarkably tantilizing and influential, Harvey's argument needs much greater specification to evaluate and apply it. Foley's approach to modeling the circuit of capital is well suited for this task. Figure 4 depicts a model synthesizing the two treatments of the circuit of capital. It recasts Harvey's primary and secondary circuits using Foley's approach to modeling the circuit. The present section introduces this model conceptually, and the next presents it in mathematical form. For simplicity, the model only considers two of Harvey's three circuits, leaving the tertiary circuit for future investigation.

The model consists solely of stocks and flows of value, with value understood according to the "new interpretation." Concrete use values, such as those in Harvey's original formulation, only enter the model insofar as they relate to turnover times, realization, and capital as value in motion. The model distinguishes between circuits of capital and circuits of revenue (Santos 2013), with priority given to the former. This is because capital accumulation occurs only in the circuit of capital, and this is the defining characteristic of capitalism Marx (1967a, Ch. 24, Sec. 3). Revenues, the parts of the process used for consumption and at the discretion of actors without direct compulsion by capitalist competition, form distinct parts of the model.

An advantage of this is to separate the circuits of capital and accumulation from the sphere of consumption and in doing so to create scope for greater openness in how revenues relate to the rest of the system through different consumption norms, wage relations, etc. Also note that a single quantum of value can appear more than once in the diagram. For example, total capital outlays include purchases of labor power (variable capital), an operation that entails a metamorphosis from money capital to nonfinancial capital. But the money spent on labor power, the wage bill, becomes a form of revenue and reappears as a flow of wages from the capitalists' stock of money capital to worker households.

In his original formulations, Foley makes a sharp distinction between productive and commercial capital. His more recent work (Foley 2013) still keeps this conceptual distinction, but his mathematical models use the sum of productive and commercial capital combined into a single category of nonfinancial capital (also see Jiang 2014). Since the distinction

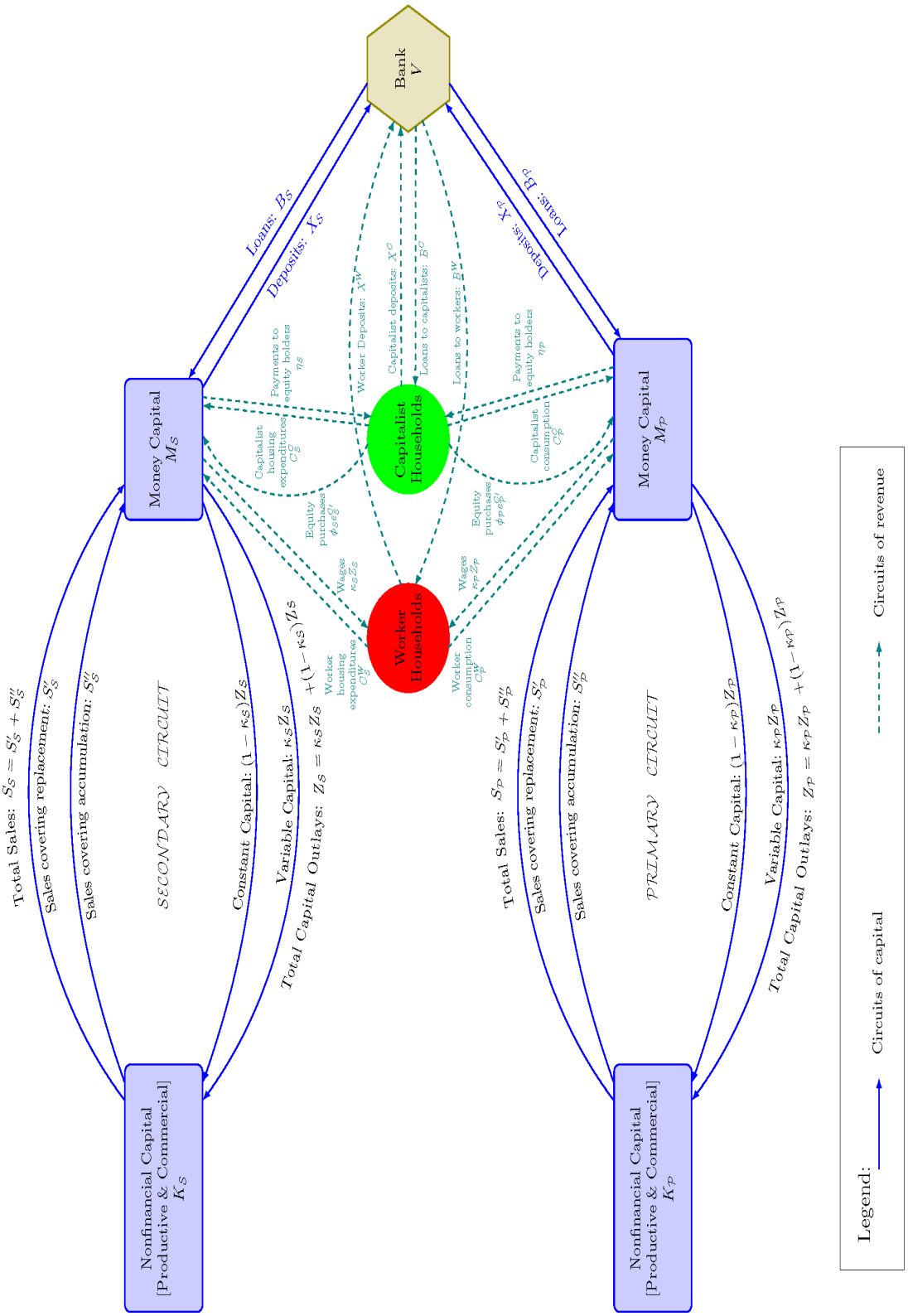

Figure 4: A synthesis of Harvey's and Foley's approaches to the circuit of capital

between productive and commercial capital raises issues regarding industrial organization and the focus of the present investigation lies elsewhere, this paper follows suit and treats productive and commercial capital as a single combined category, nonfinancial capital.

The diagram also refers to “bank capital” instead of “banking sector.” A “banking sector” contains institutions that themselves purchase means of production from the primary circuit and purchase or lease commercial real estate from the secondary sector. For simplicity, here I assume bank capital does not acquire means of production or commercial real estate and follow Santos (2011) by treating bank capital as having its impact only through consumer and business lending.

In the diagram, subscripted calligraphic capital letters distinguish the two circuits, with $\mathcal{P}$ denoting the primary circuit and $\mathcal{S}$, the secondary circuit. For simplicity, the secondary circuit is restricted to capitalistically produced elements of the built environment, mainly buildings. Infrastructure, which in contemporary capitalism is often produced either by public agencies or by capitalist firms contracted to public agencies, is not considered here. This implies that the secondary circuit is mainly residential and commercial real estate.

Each of these two circuits operate as previously described in 2.2. The two circuits are very similar, distinguished largely by different conditions of turnover and use. In each, capitalists advance a portion of the stock of money capital, M, plus any net borrowing, B, and use it to purchase nonfinancial capital consisting of labor power and means of production, Z.[7] Z.[7] The portion used for labor power, the circuit’s wage bill, reappears in the working class’ circuit of revenue. Workers use these funds to purchase consumption items from the primary circuit and housing from the secondary circuit. They also make bank deposits for saving and borrow from bank capital. All capitalist revenue comes from capitalists’ equity holdings, typically as stock dividends and net stock buybacks. Capitalists use their revenue to purchase consumption items from the primary circuit, housing from the secondary circuit, and equities from firms in both circuits. Capitalists also make bank deposits to save and to earn interest, and they take out loans.

Another portion of each circuit’s nonfinancial capital consists of products produced in the other circuit. The primary circuit produces goods and services, some of which are used as means of production. Firms operating in either circuit purchase such intermediate inputs from the primary circuit. The secondary circuit produces residential and commercial real estate, and firms operating in both circuits purchase the latter.

3 A Model of the Two Circuits[8]

This section presents a model of the circuit of capital consisting of primary and secondary (sub)circuits. The next subsection discusses the model conceptually and covers some thorny issues. Following this, Section 3 presents the mathematical model.

[7] Here the subscripts are irrelevant for the discussion and therefore are implied.

[8] This section is heavily based on the work of Foley (2013)and Rugitsky (2014).

Towards a Synthesis

Harvey builds on Marx's analysis of the circuit of capital and proposes an extension dividing the circuit into two parts: a *primary circuit* of relatively short-lived commodities and with relatively short turnover times from investment to sale and a *secondary circuit* consisting primarily of consumer durables, fixed capital, and the built environment, all of which allegedly share the characteristics of exceptionally long economic lives, long times of consumption, and long investment-to-realization turnover times. He further proposes that capitalist competition invariably leads to *overaccumulation* in the primary circuit, which potentially can precipitate crises. In such circumstances, a *switch of capital investment to the other circuits* can temporarily forestall crises. This switch transforms but does not eliminate the tendency toward overaccumulation, reproducing it in the other circuits. Insofar as the built environment constitutes a major part of the secondary circuit, it has the potential to transform the overall pattern of capital accumulation by opening geographical regions and by transforming the entire space economy of the existing mode of regulation.

While extraordinarily tantalizing and influential, Harvey's argument needs much greater specification to evaluate and to apply it. Foley's approach to modeling the circuit of capital is well suited for this task. Figure 5 depicts a model synthesizing the two treatments of the circuit of capital. It recasts Harvey's primary and secondary circuits using Foley's approach to modeling the circuit. This section introduces this model conceptually, and the next presents it in mathematical form. For simplicity, the model only considers two of Harvey's three circuits, leaving the tertiary circuit for future investigation.

The model consists solely of stocks and flows of value, with value understood according to the "new interpretation." Concrete use values, such as those in Harvey's original formulation, only enter the model insofar as they relate to turnover times, realization, and capital as value in motion, and then they are often implicit. The model distinguishes between circuits of capital and circuits of revenue (Santos 2013), with priority given to the former. This is because capital accumulation occurs only in the circuit of capital, and in the Marxist tradition this is the defining characteristic of capitalism Marx (1967a, Ch. 24, Sec. 3). Revenues, the parts of the process used for consumption and at the discretion of actors without direct compulsion by capitalist competition, form a distinct and subordinate part of the model.

An advantage of this is to separate the circuits of capital and accumulation from the sphere of consumption and in doing so to create scope for greater openness in thinking of how revenues relate to the rest of the system through different consumption norms, wage relations, etc. Also note that a single quantum of value can appear more than once in the diagram. For example, total capital outlays include purchases of labor power (variable capital), an operation that entails a metamorphosis from money capital to nonfinancial capital. But the money spent on labor power, the wage bill, becomes a form of revenue and reappears as a flow of wages from the capitalists' stock of money capital to worker households. Similarly, the diagram shows money capital being transformed into nonfinancial capital as a combination of constant and variable capital, but a portion of the constant capital is purchased from the other circuit. Firms in the primary circuit purchase urban means of production from the secondary circuit, and firms in the secondary circuit purchase

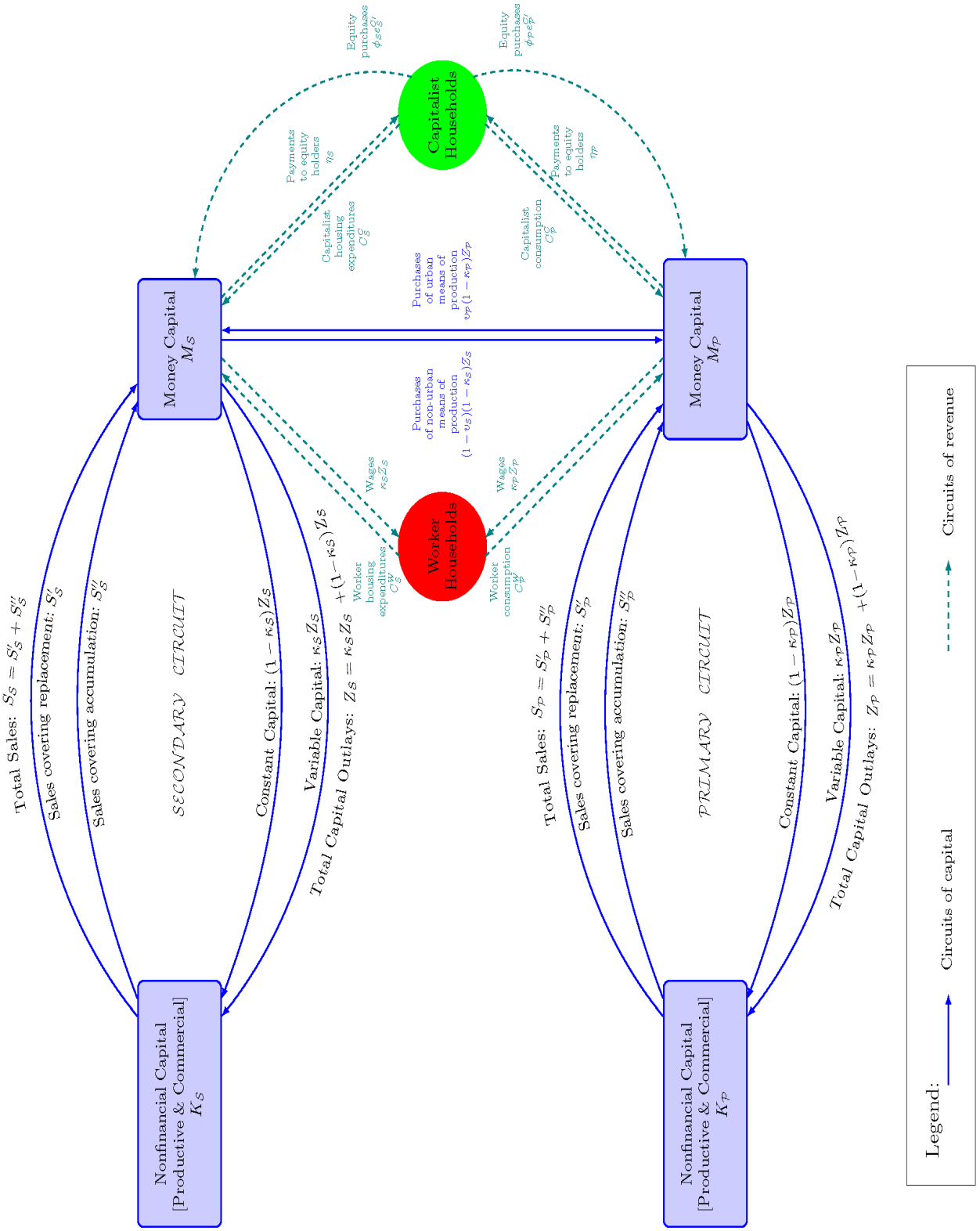

Figure 5: A synthesis of Harvey's and Foley's approaches to the circuit of capital

non-urban means of production from the primary circuit. There is a tradeoff here between making the diagram overly complex versus conceptually informative albeit with individual flows of value appearing multiple places, often subsumed in larger aggregates of value.

In his original formulations, Foley makes a sharp distinction between productive and commercial capital. His more recent work (Foley 2013) still keeps this conceptual distinction, but his mathematical models use the sum of productive and commercial capital combined into a single category of nonfinancial capital (also see Jiang 2014). Since the distinction between productive and commercial capital raises issues regarding industrial organization and the focus of the present investigation lies elsewhere, this paper ignores the distinction between productive and commercial capital and treats them as a single combined category, nonfinancial capital.

Subscripted calligraphic capital letters distinguish the two circuits, with $\mathcal{P}$ denoting the primary circuit and $\mathcal{S}$, the secondary circuit. For simplicity, the secondary circuit is restricted to capitalistically produced and sold elements of the built environment: mainly buildings, land, and private infrastructure. In contemporary capitalism infrastructure is often produced either by public agencies or by capitalist firms contracted to public agencies, and here I do not considered infrastructure built by the state or publicly owned. This implies that in the model the secondary circuit is almost entirely residential and commercial real estate. For the sake of brevity, I will refer to this category of commodities as "urban."

Each of these two circuits operate as previously described in **??**. The two circuits are very similar, distinguished largely by different conditions of turnover and use. In each, capitalists advance a portion of the stock of money capital, M and use it to purchase nonfinancial capital consisting of labor power and means of production, Z.[9] The portion used for labor power, the circuit's wage bill, reappears in the working class' circuit of revenue. Workers use these funds to purchase consumption items from the primary circuit and housing from the secondary circuit. All capitalist revenue comes from capitalists' equity holdings, typically as stock dividends and net stock buybacks. Capitalists use their revenue to purchase consumption items from the primary circuit, housing from the secondary circuit, and equities from firms in both circuits.

A portion of each circuit's nonfinancial capital consists of products produced in the other circuit. The primary circuit produces goods and services, some of which are used as means of production. Firms operating in either circuit purchase such intermediate inputs from the primary circuit. The secondary circuit produces residential and commercial real estate, and firms operating in both circuits purchase the latter.

The circuit of capital has three kinds of endogenous lags. Foley calls the time from when firms advance capital outlays to purchase labor power and means of production to when they sell their products and realize surplus value "the realization lag." He also allows for a lag from when firms sell their commodities and convert finished products into money capital to when firms recommit their money capital to the circuit and purchase new rounds of labor power and means of production, and he calls this "the finance lag." Finally, this model introduces a lag on urban purchase. This is similar to

[9] Here the subscripts are irrelevant for the discussion and therefore are implied.

the finance lag in that it is the time between obtaining money capital and recommitting it to the circuit, but for the reasons Harvey mentions – the size of the investment, the spatial and temporal fixity of the built environment, the greater risks involved, etc. (Harvey 1978) – this "urban" lag requires separate treatment.

The dialectic of real estate as use-value and exchange-value

All commodities are simultaneously use-values and exchange-values, but the tension between these two sides of this dialectic is particularly pronounced for real estate (cf. e.g., Anderson 2014; Edel, Sclar, and Luria 1984). In large part, this is due to the fact that, much more than anywhere else, ground rent in contemporary capitalism manifests itself in real-estate markets. In the mid-nineteenth century Marx wrote about landed property as a separate class(Marx 1967b, Ch. 48), but in the twenty-first century land ownership has been "democratized," primarily through widespread private home ownership, but also through atomized investment vehicles such as mutual funds specializing in real-estate investment trusts. Despite the fact that this feature of real estate played a major role in the housing bubble leading up to to the current crisis (Florida 2015; Larson 2015), recent heterodox political economy has largely ignored it.

Foley's original models made no explicit mention of real estate or housing. But his recent models, developed after the current crisis began, do explicitly incorporate housing by treating it as an asset and incorporating a housing equity target into the equations for worker household spending and saving. The models therefore emphasize the exchange-value, investment, and speculative aspects of private home ownership. The models still treats the other side of the dialectic — the use-value of housing as shelter and therefore housing's role as an item of consumption — tacitly, implicit in the single category of household consumption expenditures.

These models also are silent about real estate as a means of production and treat commercial real estate only implicitly, as part of constant capital. The value of commercial real estate is implicit in the capitalist's original expenditure of money capital on land and structures, the particle of value transmitted to the product via depreciation, and the sale price including surplus value captured through the markup on the product. This in itself is inadequate for a model such as the present one, that treats the built environment as a separate circuit of capital. Furthermore, the dialectic between use-value an exchange-value is also important in commercial real estate because real estate doubles as an asset and investment vehicle in its own right.

The present model therefore treats both aspects of real estate explicitly. It extends Foley's treatment of housing equity by introducing holdings of the built environment as a separate asset category, which can be owned by both households and by firms. It also treats the secondary circuit as if it were a distinct sector of the economy, much like Marx's two departments, and makes purchases of real estate explicit in the model. For the sake of brevity and to use a generic term for the various kinds of real estate and their underlying complexities, henceforth I call such assets "urban."

The mathematical model

The SFC modeling approach described above implies a set of accounting identities, which can be incorporated into models that can be solved analytically and/or used as the basis for computer simulations. By themselves they are sufficient for these purposes only if the various parameters are fixed and given exogenously, but one can also "close" the model by introducing additional relationships thereby making some or all of these parameters variable and endogenous (Foley 2013, 3).[10] Because extending the model this way makes turnover times variable, Harvey's definition of the primary circuit as having a fixed turnover time of one period is no longer tenable. But by introducing additional behavioral equations we may be able to reproduce the essence of his argument.

Notational conventions

Notation in these models is problematic. Because they are complex, they quickly exhaust candidate symbols with mnemonic meaning. Furthermore, the model spans several commonly segregated academic fields and subfields, each of which may have its own traditional notational conventions that are at odds with the others', so unconventional notation is common. As circuit of capital models have evolved, notational conventions used in them have changed. Even Foley's own work used different notation in the 1980s than what he uses in recent years. Here I adapt his more recent notation, modifying it when necessary.

Following Foley (2013) upper-case letters denote economic actors (firms, kinds of households, etc.), typically as superscripts. Because the model here must distinguish firms in primary and secondary circuits, as well as revenue flows from the two circuits to different kinds of households, subscript calligraphic capital letters, $\mathcal{P}$ and $\mathcal{S}$, distinguish primary from secondary circuits. For example, $C^C_{\mathcal{P}}$ denotes capitalist households' consumption expenditures in the primary circuit. Greek letters generally designate parameters, which themselves may vary. As variables, capital letters generally denote the values of stocks and flows, which also vary as functions over time.[11] Derivatives with respect to time are represented with dot notation; for example, $\dot{M}$ is the rate of change in money capital with respect to time.

Foley normalizes his models by dividing stocks and flows by total nonfinancial capital, K, eliminates the need to consider productive capital and unsold commercial capital separately, and this practice allows the stock and flow variables to be represented as fractions of the circuit's non-financial capital. If N is the total stock of productive capital and X is the stock of unsold finished commodities, then $K = N + X$ is the total stock of nonfinancial capital. Divide variables stock and flow variables by the total nonfinancial capital, and designate these normalized variables with lower-case letters. Using this convention, all capitalist firms combined hold nonfinancial capital, $k = 1$. Things are more complex with two linked circuits of capital. Abstracting from the distinction between productive and commercial capital, at any given time

[10] Foley (2013, 3)sees such other closures as potentially having greater relevance for "understanding the macro-dynamic behavior of real capitalist economies." Rugitsky (2014, 3)interprets "behavior" here as applying to the behavior of micro-economic actors, but if one allows for emergent properties, the term "behavior" may refer to organizations, institutions, or even the system as a whole.

[11] Since all stocks and flows in the model are measured in terms of labor value, the fact that these variables are functions of time and measured in value is understood and implicit hereafter.

the capitalist class as a whole holds $K = K_{\mathcal{P}} + K_{\mathcal{S}}$ in nonfinancial capital. Let $\sigma = \frac{K_{\mathcal{S}}}{K}$, the secondary circuit's share of total nonfinancial capital. Then $K_{\mathcal{S}} = \sigma K$ and $K_{\mathcal{P}} = (1-\sigma)K$, and dividing by K to normalize gives $k_{\mathcal{P}} = (1-\sigma)$ and $k_{\mathcal{S}} = \sigma$.

Aggregate demand

Aggregate demand consists of spending by firms and households. Since the value of wage bills reappear in worker households' spending, just consider firm spending on non-labor inputs (constant capital). In the primary circuit firms spend $Z_{\mathcal{P}}$, of which $(1-\kappa_{\mathcal{P}})Z_{\mathcal{P}}$ is non-labor inputs. Similar results hold for the secondary circuit. Both capitalist and worker households purchase items for consumption from both circuits. Capitalist consumption is given by $C^C = C^C_{\mathcal{P}} + C^C_{\mathcal{S}}$, and worker consumption by $C^W = C^W_{\mathcal{P}} + C^W_{\mathcal{S}}$. If R is the value of all sales at cost, then $(1+q)R$ is the market price of all sales. Since spending equals sales,

$$S = (1+q)R = (1-\kappa_{\mathcal{P}})Z_{\mathcal{P}} + (1-\kappa_{\mathcal{S}})Z_{\mathcal{S}} + C^C + C^W. \tag{1}$$

Normalizing and solving for the overall value of sales at cost gives

$$r = \frac{(1-\kappa_{\mathcal{P}})z_{\mathcal{P}} + (1-\kappa_{\mathcal{S}})z_{\mathcal{S}} + c^C + c^W}{1+q}. \tag{2}$$

If each circuit has its own markup and value of sales at cost, then the total value of sales at cost is $R = R_{\mathcal{P}} + R_{\mathcal{S}}$, and

$$S = (1+q)R = (1+q)(R_{\mathcal{P}} + R_{\mathcal{S}}) = (1+q_{\mathcal{P}})R_{\mathcal{P}} + (1+q_{\mathcal{S}})R_{\mathcal{S}} = S_{\mathcal{P}} + S_{\mathcal{S}}. \tag{3}$$

Normalizing (3), solving for the overall value of sales at cost, and combining with (2) gives

$$r = \frac{(1+q_{\mathcal{P}})r_{\mathcal{P}} + (1+q_{\mathcal{S}})r_{\mathcal{S}}}{1+q} = \frac{(1-\kappa_{\mathcal{P}})z_{\mathcal{P}} + (1-\kappa_{\mathcal{S}})z_{\mathcal{S}} + c^C + c^W}{1+q}. \tag{4}$$

Assets and classes

Each of the nodes in Figure 5 represents a societal "actor," a social class or institution. Actors are designated by superscript capital letters and include: firms, F, capitalist households, C, and worker households, W. These actors potentially can hold some combination of assets (the stock variables in the model), of which there are six kinds.

Nonfinancial capital, K, consists of productive and commercial capital, value whose movement in its circuit of capital is temporarily fixed and held by firms. These tangible assets include inputs such as raw materials, purchased components awaiting assembly, machinery and other equipment, buildings and land, and inventories of both supplies used for production and finished product. This is the basis on which the rate of profit is calculated and crucial for many things, not the least of which is a falling rate of profit in crisis theory.

F represents net financial assets. This category includes non-monetary financial assets such as loans between firms (commercial paper), stocks, or bonds, as well as monetary holdings. All net financial assets yield a common interest rate

of return, i. Firms can hold net financial assets as financial capital, but worker and capitalist households can hold net financial assets too, albeit not as capital.

All actors can hold urban assets, U. For firms, such assets are part of nonfinancial capital. For example, primary circuit firms hold $U_{\mathcal{P}}$ in urban nonfinancial capital and $K_{\mathcal{P}} - U_{\mathcal{P}}$ in other kinds of nonfinancial capital, and a similar relationship holds in the secondary circuit. Capitalist households hold two kinds of assets: equity ownership in capitalist firms and residential real estate for personal consumption.[12] Thus if A^C is all capitalist household assets and E^C is the equity held, $A^C = E^C + U^C$. Worker households, in contrast, do not hold equity in firms, so total worker household assets, A^W is given by $A^W = U^W$. In general, U is housing equity for households and commercial real estate equity for firms.

Thus the model has thirteen stock variables. Firms can hold noncommercial capital, K, net financial assets, F, and urban assets, U, which are part of total noncommercial capital. Since firms can be in either of two circuits, there are two of each of these variables. Both worker and capitalist households can have net financial assets and urban assets, accounting for four more variables. Capitalist households can also hold equities, E^C, adding another variable, and adding the value of all household assets together to get total asset values for each class adds two more. Normalized by dividing by K gives the full set of normalized stock variables: $k_{\mathcal{P}}$, $f_{\mathcal{P}}$, $u_{\mathcal{P}}$, $k_{\mathcal{S}}$, $f_{\mathcal{S}}$, $u_{\mathcal{S}}$, f^W, u^W, a^W, f^C, u^C, e^C, and a^C. Since $a^W = u^W$, only twelve variables need to be included in the model.

Assuming conservation of value in exchange (Foley 1986), these assets and relations between them imply a set of accounting equalities. To close the model, one must specify various system parameters and the mechanisms determining them for each of the actors in the model.

While we will not pursue this further here, bear in mind that in general $q_{\mathcal{S}} > q_{\mathcal{P}}$, other things being equal.

Worker household

Worker households are perhaps the simplest of the four actor categories, and Foley's treatment of worker household comes closest to the purpose of the present paper. Nonetheless, this model alters some of Foley's formulations.

The income of worker households comes from wages, $\kappa z^F = \kappa_{\mathcal{P}} z_{\mathcal{P}} + \kappa_{\mathcal{S}} z_{\mathcal{S}}$, and interest income from their net financial position, if^W. Their consumption falls into two categories: housing (urban) and other. Because all housing comes from the secondary circuit, we can use similar notation for housing and other consumption, with worker housing consumption denoted by $c^W_{\mathcal{S}}$ and other consumption by $c^W_{\mathcal{P}}$. In Foley's (2013) model, worker households treat housing solely as an investment. He models the investment aspect by assuming worker households adjust their spending to achieve a target ratio, λ^W, of the market value of housing assets to wage income. Worker household demand for housing is

[12] Insofar as capitalist households (or worker households for that matter) own investment and other rental property, they act in the role of firms. In fact, most households that own investment real estate probably do so as limited liability corporations (LLC's). Nonetheless, acting in the household role, it is possible for households to have multiple real estate holdings for personal use.

$$c_{\mathcal{S}}^{W} = \dot{u^{W}} = \beta^{W}[\lambda^{W}\kappa z^{F} - \psi u^{W}] \tag{5}$$

where ψ is the ratio of the market price of housing to production cost, and $\beta^{W}[\lambda^{W}\kappa z^{F} - \psi u^{W}]$ is the asset adjustment component, which is a function of the difference between the target value and the actual market value.[13]

Foley assumes worker households save all their interest income and use it for house purchases, leaving only wage income for other consumption, which also depends on an adjustment aiming to maintain a target ratio, ν^{W}, of net worth to wage income, with net worth including both their net financial position and their housing assets

$$c_{\mathcal{P}}^{W} = \kappa z^{F} - [g u^{W} - (i-g) f^{W}] - \alpha^{W}[\nu^{W}\kappa z^{F} - \psi u^{W} - f^{W}]. \tag{6}$$

Here g is the actual growth of the nonfinancial capital and equals $z^{F} - r$. Because g is the change in K and all stock variables in the equation are ratios and divided by K, an adjustment for the change in K is necessary to keep the ratios constant. The first two terms here represent gross income, the last term is the adjustment for net worth.

Worker households' total spending equals total spending in the two circuits

$$z^{w} = c_{\mathcal{P}}^{W} + c_{\mathcal{S}}^{W}. \tag{7}$$

Plugging (5) and (6) into (7) and rearranging terms gives

$$z^{W} = (1 - \alpha^{W}\nu^{W} + \beta^{W}\lambda^{W})\kappa z^{F} + ((\alpha^{W} - \beta^{W})\psi - g)u^{W} + (\alpha^{W} + i - g) f^{W}, \tag{8}$$

where the coefficient for κz^{F} is the marginal propensity to spend out of earnings, that for u^{W} is the marginal propensity to spend out of housing assets, and the coefficient for f^{W} is the marginal propensity to spend out of net financial position.

Net financial position, f^{W}, increases with any savings, which equals total wage income plus growth-adjusted interest income minus total spending. So

$$\dot{f^{W}} = \kappa z^{F} + (i - g) f^{W} - z^{W}. \tag{9}$$

Capitalist households

Foley's model assumes capitalist households do not own housing assets. Since housing is of central concern here, we reject this assumption. Capitalist households' income comes from dividends and other equities-related payments from firms, η, plus interest on their net financial position, if^{C}. But capitalist's spending is based on their assets rather than their

[13] We assume a single, common real estate market price adjustment, ψ, for all forms of real estate. For many years a general rule of thumb held that all but the wealthiest households could afford no more than 30% of their gross income on housing, whether it be owned or rented. With periods of rapid house-price inflation, households increasingly looked at housing as an investment. So (5) would be improved and more realistic if it had a use-value component in which worker households purchase housing strictly for shelter. Actual consumption, in terms of value, would then be he maximum of the two components. Foley and Rugitsky also limit housing expenditures to purchases of new houses. This seems overly limiting. Imagine, for example, that private home ownership were outlawed and the entire secondary circuit became a supplier of rental apartments. Here workers would be purchasing housing services rather than legal title to houses. This would eliminate the entire asset term in (5), but it would eliminate neither worker's housing expenditures nor investment in the secondary circuit and its expansion. The reason Foley and Rugitsky limit the discussion to new purchases may be to avoid treating exchanges between households as new value added, but there certainly is value added in housing services without construction and purchase of new homes.

income, and we assume that in general their income will be sufficient to cover their spending. If it is not, then capitalists will sell their equities to cover their spending.

Capitalist households' spending on urban assets is similar to that of workers (5) in that it treats housing solely as an asset. Since capitalist households also strive to maintain their net financial position, they base their urban spending solely on their dividend income, η. This gives

$$c_S^C = \dot{u^C} = \beta^C[\lambda^C \phi \eta - \psi u^C] \tag{10}$$

where ϕ is the "price" of the equities. So here $\beta^C$and λ^C play identical roles for capitalists as they did for workers in (5), only here they apply to equity income, η.[14]

Continuing in this vein, the equation for capitalists corresponding to (6) for workers is

$$c_{\mathcal{P}}^C = \rho \phi e^C - [g u^C - (i-g) f^C + g e^C] - \alpha^C[\nu^C \eta - \psi u^C - f^C] \tag{11}$$

with $0 \leq \rho \leq 1$ being the share of equity value spent. If equity income exceeds spending, capitalist households use the excess to purchase more equities. Adding (10) and (11) and simplifying results in

$$z^C = (\beta^C \lambda^C - \alpha^C \nu^C)\eta + (\rho\phi)e^C + (\alpha^C \psi - \beta^C \psi - g)u^C + (g - \alpha^C) f^C. \tag{12}$$

As before, $(\beta^C \lambda^C - \alpha^C \nu^C)$ is the marginal propensity to spend out of equity earnings, $(\rho\phi)$ is the marginal propensity to spend out of equity holdings, $(\alpha^C \psi - \beta^C \psi - g)$ is the marginal propensity to spend out of urban assets, and $(g - \alpha^C)$ is the marginal propensity to spend out of net financial position.

Firms

For the simplicity, the model has no banking sector at this stage, but Harvey (Figure 1) sees banking and money markets as the main conduit through which capital flows between circuits. Therefore, without a banking sector in the model, firms take on additional importance. Therefore, this discussion of firms begins by reviewing switching mechanisms as Harvey describes them. Following this, I present an unaltered version of Foley's model of firms. The last part of this subsection modifies Foley's model of firms to allow switching between circuits.

Switching

Pinning down the circumstances and mechanisms through which capital investment switches between the two circuits is difficult. Harvey addresses this in his seminal article (Harvey 1978). After making the very sound point that a built environment is necessary for both production and consumption, and that resources therefore must be invested in it, he

[14] If ϕ is the market price of equities, then e^C must be measured by counting the number of equities rather than some measure of their value. Further, stock-ownership equities may be considered a form of fictitious capital in that their value depends on as yet unrealized profits.

goes on to discuss obstacles to such investment. Since the present research focuses on exactly this issue, Harvey's discussion is worth quoting at length:

> ... call capital flows into fixed asset and consumption fund formation the *secondary circuit of capital*. Consider ... [how] such flows can occur. There must obviously be a 'surplus' of both capital and labour in relation to current production and consumption needs in order to facilitate he movement of capital into the formation of long-term assets, particularly those comprising the built environment. The tendency towards overaccumulation produces such conditions within the primary circuit .... One feasible if *temporary* solution to this overaccumulation problem would therefore be to switch capital flows into the secondary circuit.
>
> Individual capitalists will often find it difficult to bring about such a switch ... barriers to individual switching ... are particularly acute with respect to the built environment where investments tend to be large-scale and long-lasting, often difficult to price in the ordinary way and in many cases open to collective use by individual capitalists. Indeed, individual capitalists left to themselves will tend to under-supply their own collective needs for production precisely because of such barriers. Individual capitalists tend to overaccumilate in the primary circuit and to under-invest in the secondary circuit; they have considerable difficulty in organizing a balanced flow of capital between the primary and secondary circuits.
>
> A general condition for the flow of capital into the secondary circuit is, therefore, the existence of a functioning capital market and, perhaps, a state willing to finance and guarantee long-term, large-scale projects with respect to the creation of the built environment. At times of overaccumulation, a switch of flows from the primary to the secondary circuit can be accomplished only if the ... overaccumulation can be transformed into money capital which can move freely and unhindered into these forms of investment. This switch of resources cannot be accomplished without a money supply and credit system which creates 'fictional capital' in *advance* of actual production and consumption. (Harvey 1978, 106-7)

Several issues are present here. First, it unclear why the capitalist part of the secondary circuit, such as the real estate industry and other producers of what I am calling urban commodities, do not themselves accumulate and overaccumilate, so that at least for this part of the secondary circuit flows from the primary circuit are unnecessary. This is a particularly interesting point because precisely this sector of capital is best positioned to capture ground rent, so it may actually capture disproportionate share of surplus value, making inter-circuit flow superfluous.

Following from this, it is not at all obvious why there must be a surplus of capital and labor for investment in the secondary circuit to occur. Capital and labor routinely move between sectors and places, often leaving devastation behind. This movement is typical of uneven development in capitalism, and having a surplus of capital and labor is just one of various conditions under which it occurs.

Third, the secondary circuit is not at all unique in its need for fictitious capital and credit. Working in the circuit of capital framework, several authors have demonstrated that credit is necessary for capital accumulation in general (e.g., Santos 2011; Foley 1986; Kotz 1991).

Fourth, just because the primary circuit may experience a crisis due to overaccumulation and investing in urban infrastructure might ameliorate the crisis, this does not at all imply that capitalists, state officials, or anyone else will necessarily seek out such solutions. Conversely, historical patterns of regular waves of investment in the built environment, which Harvey (1978, 115 ff.) points to himself, suggests that rather than being the work of such visionary individuals, mechanisms are at work operating "behind the backs" of individual actors. But even with a well-functioning capital markets and a compliant state, exactly what these mechanisms might be remains unexplored.

Foley's firms

Before proceeding to introduce features into our model of the two circuits that might begin to unravel this last point, it is useful to have Foley's model of capitalist firms to build on.

Since changes in nonfinancial capital by definition equals firms' capital outlays minus the production costs of their purchases,

$$K = \dot{Z}^F - R,$$

or

$$g = z^F - r. \tag{13}$$

Foley assumes firms try to adjust their financial position to a target ratio

$$\dot{f^F} = \beta^F \left(\lambda^F z^F - f^F\right). \tag{14}$$

Firm spending then becomes

$$z^F = r + \gamma + \alpha^F(\gamma - g) - \mu^F(\lambda^F z^F - f^F) \tag{15}$$

where firms invest to replace their sales at cost, r, plus a target growth rate, γ, with a stock adjustment in the face of uncertain growth, $\alpha^F(\gamma - g)$, and and adjustment to attempt to maintain the firm's financial position, $\mu^F(\lambda^F z^F - f^F)$. Here α^F and μ^F are sales and financial accelerators.

In other words, firms spend all their sales revenue plus an increment. The balance they distribute to equity holders as dividends. With some algebraic manipulation, this is:

$$\eta = (1+q)r + (i-g)f^F - z^F - \beta^F(\lambda^F z^F - f^F). \tag{16}$$

In words, gross revenue equals sales at cost plus markup plus growth-adjusted interest income. Firms spend on capital outlays and adjust their financial position, leaving the balance from gross revenue for distribution.

Firms in a two-circuit world

One might wonder if Foley's model does not have a banking component, where does interest come from? The answer is that firms borrow from each other. This will be one channel for transfers between the two circuits. Another is equities.

Firm assets increase with total sales and net interest, and they decrease with capital outlays and net payments to equity holders. Since capitalist households can purchase equities, this last variable may be negative (i.e., issuance of new equities), and net interest may be negative as firms borrow from each other. Firms in the primary circuit hold a share of nonfinancial capital equal to $(1-\sigma)$, and those in the secondary circuit hold σ.

The target ratio, λ, by which firms adjust their financial position corresponds to Foley's finance lag, T_F in Figure 3, and for two reasons it plays a critical role here. First, as Rugitsky (2014, 5) notes, it is the lag between the time between when sales realize value surplus value as money and when this value is reinvested as capital outlays, and financialization implies an increase in this lag. Since this paper uses Rugitsky's estimates to calibrate separate models of Fordism and financialized neoliberalism, the lag also plays a crucial role distinguishing the two regimes of accumulation. Second, as discussed above, Harvey's switching thesis depends heavily on turnover time, with capital switching from the primary to the secondary circuit in the money form and through capital markets. This implies shrinkage of total capital outlay in the primary circuit, which would cause $\lambda_{\mathcal{P}}$ to increase.

In value terms, change in the primary circuit's capital stock is $\dot{K}_{\mathcal{P}} = Z_{\mathcal{P}} - R_{\mathcal{P}}$ by definition. Normalizing and taking the derivative of $k_{\mathcal{P}} = 1-\sigma$ with respect to t gives the growth rate of the primary circuit

$$g_{\mathcal{P}} = \dot{k_{\mathcal{P}}} = \frac{1}{K}\left(\sigma\dot{K} - \dot{K}_{\mathcal{S}}\right) = z_{\mathcal{P}} - r_{\mathcal{P}}. \tag{17}$$

Similarly, for the secondary circuit

$$g_{\mathcal{S}} = k_{\mathcal{S}} = \frac{1}{K}(\sigma\dot{K} - \dot{K_{\mathcal{S}}}) = \dot{z}_{\mathcal{S}} - r_{\mathcal{S}}. \tag{18}$$

The profit rate in the primary circuit is

$$\pi'_{\mathcal{P}} = \frac{q_{\mathcal{P}} r_{\mathcal{P}}}{K_{\mathcal{P}}}, \tag{19}$$

and that of the secondary circuit takes similar form.

With regard to purchases between circuits, it is convenient to consider just the primary circuit. A portion, $\kappa_{\mathcal{P}}$ of capital outlays in the primary circuit is used to purchase labor power, with the remainder used to purchase other means of production

$$Constant\ capital = (1-\kappa_{\mathcal{P}})z_{\mathcal{P}}. \tag{20}$$

Firms spend a proportion, $\upsilon_{\mathcal{P}}$, of this on urban assets:

$$\dot{u_{\mathcal{P}}} = \upsilon_{\mathcal{P}}(1-\kappa_{\mathcal{P}})z_{\mathcal{P}}. \tag{21}$$

Firms set their acquisition or divestiture of urban assets in a manner similar to the housing decisions of working class households

$$\dot{u_{\mathcal{P}}} = \zeta_{\mathcal{P}} k_{\mathcal{P}} g_{\mathcal{P}} + \beta_{\mathcal{P}}[\lambda_{\mathcal{P}} k_{\mathcal{P}} - \psi u_{\mathcal{P}}]. \tag{22}$$

Here the first term is akin to a technical coefficient in an input-output model: firms expand their holdings of urban assets in relation to the amount of growth in their assets, $k_{\mathcal{P}} g_{\mathcal{P}}$, with $\zeta_{\mathcal{P}}$ acting like a technological coefficient. In other words, at any given time firms purchase urban assets in a certain proportion to other productive assets. In addition, firms adjust their holdings relative to a target, $\lambda_{\mathcal{P}}$, which is the ratio of target urban assets relative to nonfinancial capital. The asset adjustment compares the actual value of properties owned with a target based on realized profits. Thus, (15) from Foley becomes

$$z_{\mathcal{P}}^{\mathcal{P}} = z_{\mathcal{P}} - \dot{u_{\mathcal{P}}} = r_{\mathcal{P}} + \gamma_{\mathcal{P}} + \alpha_{\mathcal{P}}(\gamma_{\mathcal{P}} - g) - \mu_{\mathcal{P}}(\lambda_{\mathcal{P}} z_{\mathcal{P}} - f_{\mathcal{P}}) - \zeta_{\mathcal{P}} k_{\mathcal{P}} g_{\mathcal{P}} - \beta_{\mathcal{P}}[\lambda_{\mathcal{P}} k_{\mathcal{P}} - \psi u_{\mathcal{P}}] \tag{23}$$

where $z_{\mathcal{P}}^{\mathcal{P}}$ is the primary circuit's non-urban purchases (purchases by the primary circuit from the primary circuit).

In the absence of a developed banking sector, firms also lend to each other. In a modern monetary system with fiat money, central banks supply the additional money required for an expansion of credit. This is the only role they play here.

For either circuit, let $p = \pi' - i$, the spread between the profit and interest rates, and appropriately subscripted for either circuit, $m = M/K$, the liquidity ratio, is the ratio of money capital to nonfinancial capital. Then assume firms consider both in deciding between borrowing to increase investment or lending to increase interest income. Borrowing and lending can be treated separately (cf. Foley 1987) or they can be integrated into a single expression in which borrowing is just negative lending (Jiang 2014)[15] With the possibility of borrowing, firms' borrowing to invest more increases with p. However, if firms have high liquidity ratios, they can fund additional investment out of their holdings of money capital without borrowing. Therefore, let $a[m, p]$ be the net additional capital outlay (or lending when negative) as a function of the liquidity ratio and profit-interest spread.[16] Total capital outlays, in the primary circuit (for example), now become

$$z_{\mathcal{P}}^{\mathcal{P}} = z_{\mathcal{P}} - \dot{u_{\mathcal{P}}} = r_{\mathcal{P}} + \gamma_{\mathcal{P}} + \alpha_{\mathcal{P}}(\gamma_{\mathcal{P}} - g) + a_{\mathcal{P}}[m_{\mathcal{P}}, p_{\mathcal{P}}] - \mu_{\mathcal{P}}(\lambda_{\mathcal{P}} z_{\mathcal{P}} - f_{\mathcal{P}}) - \zeta_{\mathcal{P}} k_{\mathcal{P}} g_{\mathcal{P}} - \beta_{\mathcal{P}}[\lambda_{\mathcal{P}} k_{\mathcal{P}} - \psi u_{\mathcal{P}}] \tag{24}$$

Here the borrowing/lending adjustment and the financial position adjustments are independent. But as financial position is defined earlier, borrowing and lending affect firms' financial positions. Therefore, for the present, we will treat the two as separate.

[15] This only works if interest rates are identical for borrowing and lending. In other words, if there are no intermediaries.

[16] If total borrowing in the economy exceed total lendings, the central bank must issue more money. So ruling out arbitrage in which firms borrow just to relend, all loans originating with firms must come out of the stock of already existing money capital, but some firm borrowing comes out of additional money issued by the Central Bank. Such "excess" borrowing constitutes the net increase in the money supply. See Foley (1987, 368).

Revisiting capitalist households

In (12) we have an expression for total spending by capitalist households. Since all their disposable income comes from equities and they use all extra income to purchase more equities, new equity purchases are

$$\dot{e} = \eta - z^C. \tag{25}$$

Now assume capitalist households purchase new equities from the two circuits in proportion to their rates of profit subject to a lag. Total equity purchases equal

$$\dot{e} = \dot{e_{\mathcal{P}}} + \dot{e_{\mathcal{S}}} \tag{26}$$

and the amount purchase from each sector satisfies

$$\frac{\dot{e_{\mathcal{S}}}}{\dot{e_{\mathcal{P}}}} = \theta(\frac{\pi'_{\mathcal{S}}}{\pi'_{\mathcal{S}}}), \tag{27}$$

where θ is a lag function. This implies, firm money capital changes relative to overall accumulation and the relative rates of profit in the two circuits. Since firms have to consciously decide to issue new equities, the equity ratio in 27 most likely is related to growth targets in the two circuits. For example,

$$\gamma_{\mathcal{S}} = \omega_{\mathcal{S}}(\frac{\dot{e_{\mathcal{S}}}}{\dot{e_{\mathcal{P}}}}) \tag{28}$$

in the secondary circuit, where $\omega_{\mathcal{S}}()$ is a positive function of the equity-purchase ratio. The primary circuit has a similar functional relationship, although it either is a positive function of the inverse of the ratio shown in (27) or it is a negative function of the ratio shown.

4 Calibration

5 Simulations

6 Conclusion

7 Appendices

Notation

Code for the Simulation Models

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