

the highest rate of absentee ownership (43.6%) occurring in Rolim de Moura. Much of this shift was represented by owners moving to nearby urban areas. Indeed, the percentage of farm households whose owners resided in urban areas increased from 6.4% to 32.2%, suggesting growing functional linkages between rural and urban sectors over time. While this finding may provide partial support for the inter-sectoral articulation "cities of peasants" hypothesis (H6), in other migration research in Rondônia we found that nearly three-quarters of the urban population in this frontier area reported living in an urban center as place of either last or second-to-last residence (Browder & Godfrey, 1997, pp. 257–259). On the other hand, the increase in absentee land ownership, when combined with the pattern of land consolidation and depopulation, especially pronounced in Rolim de Moura, suggests a significant "hollowing-out" of the certain sections of frontier as predicted by the capitalist penetration thesis (H1, H2).

Further evidence of capitalist penetration and household life-cycle patterns of development was represented by the increase in percentage of households with members working off-farm, from 23.8% to nearly 34.9%. Rather than viewing these as mutually exclusive theories, a certain positive synergy between the processes they describe is more likely to be the case. As children become young adults some may remain on the farm, others leave (perhaps temporarily) to work on other farms or in the gold mines (*garimpo*), or in the urban informal sector of the frontier. All these "off-farm" activities strengthen the linkages between the rural household and the growing regional economy.

Further evidence of capitalist penetration is found in the significant increase in the percentage of households obtaining bank credit in the previous year (from 1.6% to 22.9%), although the majority (77%) did not receive any financing and only 10% held commercial savings accounts, down from 17.5% in 1992. Curiously, there was no significant change in the percentage of the sampled farmers holding definitive land titles to farms, 57.5% and 59.4%, respectively, which may reflect a high rate of property turnover (hence titles in transference) or, simply, the possibility that informal, unofficial forms of land tenure are widely recognized and enable secure property ownership over the long term. However, definitive land title

ownership rates were significantly higher in Rolim de Moura than in either of the other two study sites in 2002, further indicating a greater degree of market integration in Rolim de Moura than in Nova União or Alto Paraíso. Only one of the study sites (Nova União) had a significantly higher rate of collective land tenure arrangements in 1992, but multiple household properties dropped there by 39% in 2002. In 2002, only 17.9% of the properties in the Rolim de Moura sub-sample included multiple households, indicating that rural property there had become more thoroughly privatized into single owner properties. One important indicator of the capitalist penetration thesis, and the degree of economic integration, is the rate of household borrowing from commercial lending institutions. In 1992, Rolim de Moura's residents enjoyed a significantly higher rate of bank loan use, although very small in any case (5.9%). However, by 2002 the percentage of households acquiring bank loans increased dramatically across the three study sites, with the highest rate of borrowing unexpectedly occurring in Nova União. It is important to note that farmers throughout the State of Rondônia were eligible for various government credit programs brokered through private banks, some financed by the World Bank's PLANAFLORO program. Therefore, the growth in the rate of financial participation of the rural population may not reflect capitalist penetration as much as government involvement in credit markets. In general, however, the spatial differences in these household indicators tend to indicate that Rolim de Moura more closely fits the outcomes predicted by the capitalist penetration thesis, while household life-cycle factors are more frequently indicated in the other study sites.

6. DISCUSSION

The purposes of this paper are to describe general patterns of development that have emerged in Brazil's Amazonian "post-frontier" and to offer a preliminary assessment of the validity of the predictions offered by three distinct theoretical perspectives, some now more than 30 years old. Has the frontier changed as predicted by one brand of neo-Marxist scholars toward progressive penetration of capitalism, displacing traditional forms of production, and ultimately imploding into a "hollow frontier" controlled by local oligarchs linked to national capitalist elites, and occasionally global

Table 9. *Comparative validity of theoretical frameworks*

Theoretical framework/hypotheses	Socio-economic validity	Spatial validity
<i>1. Capitalist penetration theory</i>		
H1. Property consolidation	Selective	Selective
H2. Rural depopulation	General	General
H3. Peasant impoverishment	Selective	Selective
H4. Total deforestation/Cash monocultures (cattle, soy)	General	Selective
<i>2. Inter-sectoral articulation theory</i>		
H5. Persistence of the peasantry	Selective	General
H6. Urbanization from rural exodus ("cities of peasants")	Selective	General
H7. Production shift toward annual food crops	Invalid	Invalid
<i>3. Household life-cycle theory</i>		
H8. Property sub-division	Selective	General
H9. Rural depopulation (especially children)	General	General
H10. Production shift away from annual and perennials and to cattle.	General	Selective
H11. Deforestation stabilizes/secondary growth increases	Invalid	Invalid
H12. Value of household production increases	Selective	General

markets? Or, has the peasantry persisted albeit as an impoverished social class articulated to the process of urban industrial development as low-budget food producers? Perhaps, the changes observed over this 10-year study period can be more comprehensively explained by changes in household labor composition associated with the natural evolution of the family life-cycle.

To systematically assess the evidence for these claims, comparative statistical analyses of 12 hypotheses were conducted using the 10-year longitudinal panel data derived from the 1992 and 2002 surveys of 240 households in three study sites in Rondônia, Brazil. Each hypothesis was evaluated in two distinct domains: socio-economic and spatial. Each hypothesis could be validated in "general," across farmer types (socio-economic classes) and spatial locations (study sites); in "selective" socio-economic classes and spatial locations; or "invalid" (not appearing valid in either domain). The findings do not conclusively support any single theoretical perspective on predicted patterns of development in the Amazonian Frontier (Table 9).

Only one pattern meets the criterion of "general" validity in both socio-economic and spatial contexts: "rural de-population;" the significant decline in rural population is generalized across socio-economic strata and geographic study sites. Two other hypotheses are "invalid" in both contexts: H7—the production shift toward annual food crops; and H11—the stabilization of deforestation rates and the

resurgence of secondary growth. The remaining hypotheses are either generally or selectively valid in one or both domains. The patterns of development discerned from this study are socio-economically differentiated and, to some degree, spatially diverse. These findings suggest that no single or unified theory of frontier expansion adequately explains the various nuances that appear at different times and places in the Amazon.

Local agency plays a decisive role in mediating the driving forces of economic expansion and aging households. For example, Rolim de Moura, formerly a major banking center during the frenzied years of the Brazilian mahogany boom (*ca.* 1980–85), was linked to the global economy in the very first years of its existence (Browder, 1986, 1987). Three important local political figures became prominent in state and national government, conferring upon this locality preferential public sector benefits not enjoyed by other communities, such as government funding to pave the road linking the town to the interstate highway BR 364 and incentives to a private meat packing company to establish a slaughterhouse in Rolim de Moura in the late-1990s, clearly stimulating the growth of cattle production, now the basis of the local economy. By contrast, Nova União, separated from the *município* of Ouro Preto D'Oeste, had a long tradition of rural labor activism and agrarian communalism. The original home of Rondônia's Landless Rural Workers Movement (MST), its farmers mobilized to create various rural syndicates

and associations, like the Association of Alternative producers (APA), some closely linked with the National Workers Party and the Brazilian Socialist Party. The relative political radicalism of this rural community made it a less inviting environment for capitalist expansion. Alto Paraiso had a strong tradition of syndicated coffee cooperatives, imported from Parana in the South of Brazil. Politically conservative, with a strong religious center (Maryknolls) and focused on preserving family farm production, this study site also managed to successfully resist the rapid domination by socio-economic elites. Understanding these contextual local nuances is essential for accurately interpreting the results of survey research. Such nuances are frequently inconsistent with many of the outcomes predicted by both the structuralist and the demographic models that have provided the major interpretative frameworks for frontier expansion in Amazônia for several decades.

7. CONCLUSIONS

Since the late-1970s scholars have speculated about the nature and dynamics of frontier expansion in Brazilian Amazônia, predicting outcomes of this historical experience based on three major conceptual frameworks: *capitalist penetration theory*, *inter-sectoral articulation theory*, and *household life-cycle theory*. This paper revisits those theoretical models and their predictions based on the empirical survey described above. We conclude that no single, unified theory of frontier expansion adequately explains the various nuances of reality that appear at different times and different places in the Amazon. This general conclusion does not negate the importance of several important patterns of development in Brazilian Amazônia to be inferred from the three case studies in Rondônia reported herein.

First, during this 10-year period a generalized pattern of socio-economic stratification has occurred within the rural population emanating from the complementary processes of property subdivision and consolidation, both complicated by the emergence of a second generation of rural residents. These property transactions (affecting more than one-half of the property owners surveyed) have occurred in conjunction with two other generalized trends emerging from Rondônia's post-frontier: declining rural population and increasing cattle production

across the study sites. All three of these trends were anticipated by both the capitalist penetration and the household life-cycle theses, although for different reasons.

Second, despite predictions that these colonist farming systems would be ecologically and financially unsustainable, the majority of farms in the survey sample saw the real *per capita* net value of production grow during the 10-year study period. It may be convincingly argued that this growth in production, bringing with it enhanced economic welfare for most of Rondônia's rural inhabitants, has come at the expense of the natural capital stock (i.e., natural forests) that has been progressively converted to pasture during this 10-year study period. This relative prosperity of the agrarian class would run counter to the claims made by the two neo-Marxist structuralist perspectives examined here, and add some luster to the household life-cycle thesis. Given the impending exhaustion of Rondônia's forest capital stock, however, only time will tell whether Rondônia's farming population will be able to adapt their production technologies to the changing conditions of a depleting resource base. An alternative scenario, the continued attrition of the rural population and the acceleration in concentration of land ownership, posits a future of heightened rural poverty and urban growth, outcomes anticipated by the capitalist penetration thesis. Moreover, the concomitant shift in production away from both perennial and annual food crops suggests that the local agrarian economy has become less self-sufficient in food production and more dependent on national food chains, an inference that is borne out in other research (e.g., Browder & Godfrey, 1997), a conclusion that adds validity to the capitalist penetration thesis.

Third, during this transitional time period, between frontier and post-frontier, the increasing influence of urban centers found in the survey data is noteworthy. During this 10-year study period, a significant proportion of the rural property owners in the sample frame moved to nearby urban centers, leaving their properties to relatives or tenants. Similarly, a growing percentage of the rural population worked off-farm, many in urban-based jobs. While it would be natural to expect (as the survey data confirm) that aging pioneers and post-primary rural school children would be well represented among those migrating to neighboring towns and cities (where better

medical and educational services are available), other research (Browder & Godfrey, 1997) does not substantiate the claim (by proponents of inter-sectoral articulation) that the post-frontier's burgeoning urban population consists mainly of former peasants. Rather, the preponderant tendency is for these towns to be populated by persons with long-standing urban biographies in other regions of origin. Still, a significant proportion of the urban population in Rondônia cited rural locations as their last place of residence, leaving open the inter-sectoral articulation thesis to partial validity.

In the end, we find that no single unified theory of frontier expansion accurately predicts the patterns of development revealed from this 10-year comparative survey of Rondônia's agrarian frontier. Various processes appear to be operative, each playing out a bit differently given the specific contextual forces embedded in different localities.

Household life-cycle dynamics clearly play a decisive role in explaining the changes encountered during this 10-year period in Rondônia. However, the emergence of a second generation of rural residents (constituting over 40% of the 2002 survey sample) in this post-pioneer period complicates any linear extrapolation of patterns of development based entirely on the household economy model. That this second

generation of households may differ from the original pioneers in the range of their assets, their political connections, and access to capital suggests that their land-use decisions may be different as well. An increasingly urban-based, absentee owner population suggests that rural property ownership is but one component of a more complex strategy of livelihood production and asset accumulation in the post-frontier increasingly populated by an emerging second generation of property owners.

Capitalist penetration and inter-sectoral articulation theories also provide compelling story lines but the empirical evidence of the impacts of capitalist expansion is class-specific and spatially selective, not easily generalized throughout the rural population. In hindsight, the predictions offered by structuralist scholars thirty years ago do not adequately resemble the Amazonian "post-frontier" reality today. Local agency, institutional histories, and the actions of individual people, especially potent in the formative years of a new frontier, create unique local contexts in which the driving forces of change are played out with considerable variability between places. Understanding the central importance of locality, then, is essential for understanding the patterns of development in the Amazonian post-frontier.

NOTES

1. Certainly, there are some comparisons. In both the United States and Brazil, the "frontier experience" lasted about 45 years, spanning two generations. In the United States, the benchmarks extended from the 1848 gold rush to Turner's famous frontier eulogy in Chicago in 1892 (44 years). And, from roughly 1966–2002 (46 years), the Amazon, or at least significant sections of the region, have experienced structural transformations in its social and economic character. While many forces, global, national, and local, influence the structural changes underway in Amazonia, it is noteworthy that a second generation of occupants is emergent, and their decisions will seal the future of the Amazon's rain forests in the post-frontier.

2. Aggregate change can be observed across time using census documents, but such data mask household experiences. By ecological fallacy, in-migrants contrasting sharply with long-term residents could give the

impression that these same residents have changed their characteristics (e.g., level of education, income level) when in fact they have not.

3. In particular, frontier theory often addresses conflictive social relations between large and small holders, with a special concern for land expropriations that push small holders off their properties. Aggregate data, while showing land distribution, cannot detail the social dynamics leading to distributional outcomes, which household-based studies can (Aldrich *et al.*, 2006).

4. The frontier thesis as originally proposed by Frederick Jackson Turner in 1893 and elaborated in 1920 described the process by which the American West evolved from an unsettled wilderness to a highly productive and complex system of integrated settlement,

which ultimately influenced the democratic institutions that he claimed made America strong (Turner, 1920). Others following on Turner's thesis incorporated notions of economic development, and outlined stages whereby the frontier landscape was transformed from wilderness to agriculture, and eventually into a mature central-place system (Bylund, 1960; Hudson, 1969; Olsson, 1968). In fact, this theory of frontier expansion was the blueprint dictating development programs initiated in Brazil in the post-World War II period that were intended to integrate the Amazon, both economically and politically, with the rest of the country (Browder, 1988; Browder and Godfrey, 1997).

5. The standing authority on the Amazon Rubber Boom is Weinstein (1983), who does not refer much to Rondônia in her history. Several other books by Brazilian historians and commentators document occupation of the Territory from the early colonial period to the present day including Gomes da Silva (1983), Pinto (1993), FUNCER (n.d.). We have endeavored to sum-

marize several of these authors in our recent work (Browder & Godfrey, 1997, pp 164–175).

6. A small sampling of the headlines and feature stories during 1987–89 conveys the extent and tone of public concern in both the United States and Brazil over the massive deforestation unleashed by POLONOROESTE in Rondônia. For example, "Brazilian Rain Forest on Road to Extinction" (*Boston Globe*, December 18, 1988); "The Rain Forest's Road to Ruin: Ecologists Decry World Bank Role in Building Brazilian Highway" (*Washington Post*, July 24, 1988); "Torching the Amazon: Can the Rain Forest Be Saved?" (*Time*, September 18, 1989); "Rondônia Lost 11% of its Forests Along the BR 364 [Highway] Route" (*Jornal do Brasil*, July 19, 1987, author's translation).

7. The slight change in property size for Type I farmers during 1992–2002 is due to the elimination of 1992 respondents who could not be interviewed in 2002, thereby readjusting the mean for this category.

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