Fiscal Policy with Heterogeneous Agents and Risky Home Production: The Case of South Africa

Yoseph Getachew

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By

Yoseph Getachew

Department of Economics,

University of Pretoria, Pretoria

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Abstract

This paper develops and calibrates a heterogeneous-agent Aiyagari-type model tailored to a developing economy. The model incorporates stochastic home production, endogenous human capital investment, and incomplete capital markets. In contrast to standard incomplete-market models that typically predict excessive capital accumulation, the framework shows that when home and market goods are complements and home production is subject to idiosyncratic risk, households' smooth consumption primarily through intertemporal time reallocation rather than intertemporal saving. As a result, labor and resources shift away from the market sector, leading to lower equilibrium capital accumulation. The model is calibrated to an emerging African economy and used to evaluate the macroeconomic and distributional effects of fiscal policy when households face shocks to both market productivity and home production. A five-percentage-point increase in the income tax rate reduces market capitalisation, output, and investment in human capital. The policy also lowers income and consumption inequality, but increases wealth inequality. These results highlight the importance of sectoral risk and household time allocation for evaluating fiscal policy in developing economies.

Keywords— Fiscal policy, heterogeneous-agent, incomplete market, stochastic home production

1 Introduction

A standard implication of heterogeneous-agent incomplete-market models is that idiosyncratic risk induces precautionary savings and, in equilibrium, excessive capital accumulation relative to the complete-markets benchmark. In canonical Bewley–Aiyagari environments, uninsured income risk combined with borrowing constraints generates self-insurance motives that depress interest rates and raise aggregate capital. While this mechanism is well-suited to advanced economies with developed financial systems, it sits less comfortably with the macroeconomic realities of many developing and emerging economies, where chronic capital shortages, low investment, and weak financial intermediation are central features. In such settings, capital market imperfections and exposure to multiple sources of risk are associated with under-accumulation rather than over-accumulation of capital.

This paper develops a heterogeneous-agent model designed to reconcile incomplete markets with low equilibrium capital in developing economies. The model consists of ex-ante identical but ex-post heterogeneous households that accumulate risk-free assets, invest in human capital, and allocate one unit of effective time between market work and home production. The government finances public consumption and lump-sum transfers through proportional taxes on labor and capital income. Transfers provide partial social insurance, particularly for low-income households that face limited access to credit and insurance markets.

We thus extend the Bewley–Aiyagari model (Aiyagari, 1994) along two dimensions: (i) we introduce stochastic home production, and (ii) we allow for endogenous human capital investment. Households face idiosyncratic shocks to both market productivity and home production and allocate time between sectors. When home and market goods are complementary, and home production is risky, households smooth consumption primarily through intratemporal reallocation rather than intertemporal precautionary saving. As a result, equilibrium market capitalisation can fall below the level predicted by standard incomplete-market models without home-sector risk. The mechanism operates through a reduced labour supply in the market and weaker incentives to accumulate financial assets.

We apply the model to study the macroeconomic and distributional effects of fiscal policy in an emerging economy characterized by incomplete markets and risky household production. In contrast to much of the literature, which typically confines idiosyncratic risk to labor income, our framework explicitly models uncertainty in both the market and home sectors and allows households to adjust efficient labor allocation endogenously. This richer environment generates different implications for capital accumulation, consumption smoothing, and the distributional effects of fiscal policy.

The model is calibrated to the South African economy. South Africa provides an informative case study for two reasons. First, despite major institutional reforms since the end of Apartheid, the economy continues to face persistent structural challenges. Youth unemployment is close to 60 percent, average economic growth has remained near 1 per- cent over the past decade and a half, and income inequality remains among the highest in the world. The Gini coefficient increased from approximately 0.66 in the mid-1990s to around 0.69 in recent years. Second, relative to many emerging economies, South Africa has a large fiscal footprint. Public spending on social sectors reached roughly 14 percent of GDP in 2019, while the tax-to-GDP ratio stood at 27.1 percent in 2022 (World- Bank, 2022). Fiscal policy, therefore, plays a dual role: distortionary taxation may reduce efficiency and capital formation, whereas transfers and social spending provide partial insurance in an environment with limited private risk-sharing mechanisms.

Quantitatively, fiscal distortions generate substantial long-run effects. A five-percentage-point increase in the income tax rate reduces most macroeconomic aggregates. Market capital and education investment decline by approximately 13–18 percent, while consumption of market goods falls by 6–13 percent. Home goods consumption also declines as overall productive capacity contracts. The magnitude of these effects depends on the elasticity of substitution between home and market goods, with greater substitutability partially buffering households against income losses under incomplete markets. The distributional implications are more nuanced. The tax increase reduces income, consumption, and human capital inequality, largely through lower education investment among upper-income households. At the same time, inequality in financial wealth increases, as higher transfers reduce precautionary savings among lower-income households.

This paper contributes to four strands of literature. First, it relates to models of risky human capital in incomplete markets (Gottardi, Kajii, and Nakajima, 2015; Krebs, 2003, 2006). Unlike that literature, which often assumes complete credit markets for tractability, we maintain borrowing constraints and focus on quantitative implications. Second, it connects to heterogeneous-agent analyses of fiscal policy (Alonso-Ortiz and Rogerson, 2010; Heathcote, 2005), but differs by incorporating sectoral risk and endogenous home production in a multi-sector environment. Third, it complements the literature on inequality, public policy, and growth (Benabou, 2002; Chatterjee and Turnovsky, 2012; Garcia-Penalosa and Turnovsky, 2007; Getachew and Turnovsky, 2015, 2020), which typically relies on stylized heterogeneity or complete markets. Finally, it extends the home-production literature (Benhabib, Rogerson, and Wright, 1991; Chen, Chu, and Lai, 2018; Greenwood, Rogerson, and Wright, 1995; McGrattan, Rogerson, and Wright, 1997; Parente, Rogerson, and Wright, 2000) to a heterogeneous-agent incomplete-markets setting.

The remainder of the paper is organized as follows. Section 2 presents the model. Section 3 discusses calibration. Section 4 reports the baseline results. Section 5 examines the role of uncertainty in the home-production sector. Section 6 presents fiscal policy experiments. Section 7 concludes.

2 The Model

The economy is populated by a continuum of infinitely lived agents of unit mass. Households are ex-ante identical but become ex-post heterogeneous due to uninsured idiosyncratic shocks to their market productivity (human capital) and to home production. Markets are incomplete: agents can trade a single risk-free financial asset subject to a borrowing constraint, but there are no state-contingent claims.

Production takes place in two sectors. In the market sector, firms operate a standard neoclassical technology using physical capital and efficient labor. In the home sector, households combine efficient time and capital to produce home goods. Aggregate consumption is a composite of market and home goods, with the elasticity of substitution governing intratemporal allocation.

Each household is endowed with one unit of time per period, measured in efficiency units. Time is allocated among market work, home production, and human capital investment. Human capital evolves endogenously through education investment and depreciates over time. Idiosyncratic shocks affect both market productivity and home production efficiency, generating risk in both income and non-market consumption.

Households choose consumption of market and home goods, savings in the risk-free asset, investment in human capital, and time allocation across activities to maximize expected lifetime utility. The borrowing constraint limits the ability to smooth shocks intertemporally, giving rise to precautionary savings motives. At the same time, intratemporal substitution between home and market production provides an additional smoothing margin.

The government levies proportional taxes on labor and capital income. Revenues finance public consumption and lump-sum transfers. Transfers provide partial insurance against low-income realizations. The government budget is balanced each period.

A stationary competitive equilibrium consists of household policy functions, factor prices, aggregate allocations, and a stationary distribution over individual states such that households optimize, firms maximize profits, markets clear, and the government budget constraint holds. We compute the stationary equilibrium in detrended (per-capita output) terms.

2.1 Households

Suppose the expected discounted lifetime utility of the *i*th agent is given by:

$$E_t \sum_{t=0}^{\infty} \beta^t u\left(c_{it}\right) \tag{1}$$

The utility function takes the following constant relative risk aversion (CRRA) form:

$$u\left(c_{it}\right) \equiv \frac{c_{it}^{1-\sigma} - 1}{1-\sigma} \tag{2}$$

where E_t is the expectation operator based on information available at time t. c_{it} represents the agent's total consumption, and β is the discount factor. σ is the intertemporal consumption elasticity of substitution. Following the home production literature, the aggregate consumption of the agent is composed of market consumption $\tilde{c}_{it,m}$ and home consumption, $\bar{c}_{it,h}$; subscripts m and h stand for market and home goods, respectively:

$$c_{it} = \left(\iota c_{it,m}^{\upsilon} + (1-\iota)\, c_{it,\bar{h}}^{\upsilon}\right)^{\frac{1}{\upsilon}} \tag{3}$$

where υ and $\epsilon \equiv 1/(1-\upsilon)$ is the elasticity of substitution. The case $\upsilon < 0$ implies home goods and market goods are complementary.

The agent's lifetime utility is subject to the budget constraint,

$$k_{it+1} + c_{it,m} + e_{it} = \left(r_t\left(1-\tau^k\right) + 1\right) k_{it,m} + \tilde{y}_t + T_t \tag{4}$$

The left-hand side of Eq. (4) constitutes the agent's total asset holding (k_{it+1}), investment in human capital (e_{it}) and after-tax market consumption. The right-hand side is their income, which constitutes after-tax capital and labor income, and government transfer (T_t). $\tilde{y}_t$ is the after-tax labor income of the agent.

$$\tilde{y}_t \equiv \left(1-\tau^y\right) w_t \eta_{it,m} u_{it} h_{it} \tag{5}$$

The agent supplies $u_{it}h_{it}$ unit of of efficient labor where h_{it} is the agent's human capital stock at time t. The remaining efficient labor is used for home production. Physical and human capital are depreciated according to δ^k and $\delta^{h,}$ respectively.

$$c_{it,h} = \eta_{it,\bar{h}} b_2 \left(n_{it} h_{it}\right)^{\xi} k^{1-\xi}_{it,h} \tag{6}$$

where $n_{it} \equiv 1 - u_{it}$. $k_{it,m}$ and $k_{it,\bar{h}}$ are market and home capital; and r_t is the interest rate on the market capital and w_t is the market wage rate. $\eta_{it,j}$ represents the agent's productivity in the jth sector.

$$\ln \eta_{it+1,j} = \rho_j \ln \eta_{it,j} + \zeta_{it,j} \tag{7}$$

where $j \in \{m, \bar{h}\}$. The shocks $\zeta_{it,j}$ are assumed to be i.i.d., normally distributed with mean zero and variance σ^2. The policy parameters τ^k and τ^y denote taxes on capital and labor income, respectively. For a proper home production economy, the following restriction shall hold:

$$\upsilon < 1; \xi \in (0, 1) \tag{8}$$

The case $\upsilon = 0$ and $\xi = 1$ yields predictions for market variables that are identical to the economy without home production (Benhabib et al., 1991).

The production of human capital takes the following form, in the spirit of Ben-Porath (1967):

$$h_{it+1} = b_1 e_i^{\varpi} y_t^{1-\varpi} + \left(1-\delta^h\right) h_{it} \tag{9}$$

where $\varpi \in (0, 1)$. b_1 and b_2 are productivity parameters in the human capital and home production sectors; y_t is aggregate output, which captures externality in human capital production.

Agents face credit constraints in their liquid assets:

$$k_{it+1} \geq -\phi_t \tag{10}$$

where $\phi_t > 0$ represents an *ad hoc* debt limit.[1] It restricts the agent from carrying over a negative liquid asset (debt) beyond a certain amount $-\phi_t$.

[1] The borrowing limit could be endogenously determined and expressed as the natural debt limit (see Aiyagari, 1994).

2.2 Firm

We suppose a single market good is produced by a representative firm using aggregate efficient labor and market capital.

$$y_t = zk_{t,m}^{\alpha}\left(u_t h_t\right)^{1-\alpha} \tag{11}$$

where y_t is aggregate output, and α is the share of aggregate market capital. z is total factor productivity (TFP) in the goods production sector. The firm's profit maximization leads to the following prices.

$$w_t = (1-\alpha)\, z \left(\frac{k_{t,m}}{u_t h_t}\right)^{\alpha} \tag{12}$$

$$r_t = \alpha z \left(\frac{k_{t,m}}{u_t h_t}\right)^{\alpha-1} - \delta^{k} \tag{13}$$

2.3 Government

We suppose the government budget is balanced.

$$T_t + g_t^c = \tau^k r_t k_t + \tau^y w_t u_t h_t \tag{14}$$

The government expenditure includes government consumption g_t^c and government transfer T_t, which is financed through government revenue raised from capital and labour income taxes.[2] As we see later on, for the policy experiment, we hold g_t^c/y_t constant and vary T_t/y_t, following Floden and Linde (2001).

2.4 Solution to the Agent's Problem

2.4.1 Euler equations

Solutions to the agent's problem include the two Euler equations and the trade-off between home and market goods consumption. The Euler equations associated to physical and human capital, respectively are given as follows.

[2] Including government debt and net imports, as Nakajima and Takahashi (2020), to finance government expenditure will not change the results.

$$c_i^{1-\sigma-\upsilon} c_{it,m}^{\upsilon-1} = \beta c_{it+1}^{1-\sigma-\upsilon} c_{it+1,m}^{\upsilon-1} \left(r_{t+1}\left(1-\tau^k\right)+1\right) \tag{15}$$

$$c_i^{1-\sigma-\upsilon} c_{it,m}^{\upsilon-1} e_i^{1-\varpi} = \beta c_{it+1}^{1-\sigma-\upsilon} c_{it+1,m}^{\upsilon-1} \left(\left(1-\delta^h\right) e_{it+1}^{1-\varpi} h_{t+1}^{\varpi-1} + \varpi b_1 \left(1-\tau^y\right) w_{t+1}\eta_{it+1}\right) \tag{16}$$

2.4.2 Home–market allocation

The intratemporal optimality condition governing the allocation of labor between market and home production is given by

$$n_{it} h_{it}\, \varrho^{-\kappa} \chi^{\kappa\upsilon(\xi-1)} \left(w_t \eta_{it,m}\right)^{\kappa(1-\upsilon(1-\xi))} \left(\eta_{it,h} \bar{b}_2\right)^{-\upsilon\kappa} = c_{it,m}, \tag{17}$$

where

$$\kappa \equiv \frac{1}{1-\upsilon\,\iota\left(1-\tau^y\right)^{-1}} \tag{18}$$

$$\varrho \equiv \left(\frac{\xi(1-\iota)}{(1-\xi)\left(1-\tau^y\right)}\right) \tag{19}$$

$$\chi \equiv \frac{}{\xi\left(r\left(1-\tau^k\right)+1\right)} \tag{20}$$

Equation (17) summarizes how sectoral productivity shocks affect the home–market labor margin when $\upsilon \neq 0$. The elasticity parameter υ governs whether shocks reinforce or offset each other through intratemporal substitution.

If goods are complements ($\upsilon < 0$), higher productivity in either sector raises the marginal value of the other good, inducing a positive comovement between productivity and market labor supply. If goods are substitutes ($\upsilon > 0$), a positive home productivity shock reduces market labor supply. In the Cobb–Douglas case ($\upsilon = 0$), income and substitution effects offset exactly, and home productivity shocks do not affect market labor allocation.

2.4.3 Capital–labor trade-off in home production

The optimality conditions also imply that

$$k_{it,\bar{h}} = \chi w_t \eta_{it,m} h_{it} n_{it} \Leftrightarrow \frac{r(1-\tau^k)+1}{(1-\tau^y) w_t \eta_{it,m}} = \frac{(1-\xi) h_{it} n_{it}}{\xi k_{it,\bar{h}}} \tag{21}$$

Condition (17) equates the relative opportunity cost of capital and labor in home production to their relative marginal products. The after-tax gross return $r(1-\tau^k)+1$ is the cost of allocating capital to the home sector, while $(1-\tau^y) w_t \eta_{it,m}$ captures forgone after-tax market earnings. Taxes therefore distort the home–market margin by altering relative factor prices.

2.4.4 Consumption allocation

The implied home–market consumption ratio is

$$\frac{c_{it,h}}{c_{it,m}} = \left[\left(\varrho \eta_{it,h} \bar{b}_2 \right)^{-1} \left(\eta_{it,m} w_t \right)^{\xi} \chi^{\xi-1} \right]^{\frac{1}{\upsilon-1}} \tag{22}$$

Consumption shares are independent of individual wealth and depend only on relative productivities, prices, and tax distortions. Thus, uncertainty affects consumption composition exclusively through its impact on the intratemporal allocation condition.

2.5 Elasticity, Risk, and Resource Allocation

Closed-form solutions for the full dynamic system are not available. However, equations (17)–(22) clearly show the mechanism through which sectoral risk influences equilibrium outcomes.

2.5.1 Cobb–Douglas case ($\upsilon = 0$)

When $\upsilon = 0$, equation (17) reduces to

$$\varrho^{-1} \eta_{it,m} w_t n_{it} h_{it} = c_{it,m} \tag{23}$$

Home productivity does not enter the labor allocation condition. Resource reallocation across sectors provides a direct consumption-smoothing margin: in low market states, the opportunity cost of home production declines and agents shift labor toward the home sector.[3] Because this margin absorbs market risk, precautionary saving incentives are attenuated. Home-sector volatility affects only the level of home consumption (22), not savings behavior.

[3]The agent forgones $\eta_{it,m} w_t n_{it} h_{it}$ amount of before tax income by working at the home sector. Thus, the term in the left-hand side of (23) is the opportunity cost of home good consumption.

2.5.2 General case ($\upsilon \neq 0$)

When $\upsilon \neq 0$, home productivity risk influences both intratemporal allocation and precautionary savings. If goods are complements ($\upsilon < 0$), market and home shocks reinforce each other. In joint downturns, agents expand home production, making resource re-allocation the primary smoothing channel. Strong complementarity, therefore, weakens precautionary saving motives and can reduce equilibrium capital accumulation. If goods are substitutes ($\upsilon > 0$), shocks are partially offset in terms of labor allocation. In this case, intertemporal saving becomes the dominant smoothing mechanism, strengthening precautionary motives. Hence, the elasticity parameter υ determines whether equilibrium risk adjustment operates mainly through intratemporal reallocation or through capital accumulation.

3 Calibration

We now turn to the quantitative assessment of the model. We first compute the stationary equilibrium (balanced growth path) and then evaluate the effects of tax and transfer changes on long-run allocations. Following Nakajima and Takahashi (2020), we transform all variables into stationary form by expressing them in per-capita output units. For any aggregate variable x_t, we define $\tilde{x}_t \equiv x_t/y_t$, where y_t denotes aggregate income. This transformation renders the equilibrium stationary and facilitates comparison across policy regimes.

The model is calibrated to match key individual- and aggregate-level features of the South African economy (Table 1). We set the transfer-output ratio $v \equiv T_t/y_t$ equal to 0.037. Government transfers in South Africa range between 3.3 and 4.1 percent of GDP. Average social spending over 2009–2016 is approximately 3.3 percent of GDP (Weltbankgruppe, 2021). Hollander, Havemann, and Steenkamp (2024) report that social benefits amount to roughly 3.5 percent of GDP and about 10.7 percent of total government expenditure, covering approximately half of the population.

For tax parameters, we follow the effective tax rate methodology of Mendoza, Razin, and Tesar (1994). Using South African data for 1990–2002, Amusa (2004) estimates average effective tax rates of 15 percent for labor income and 28 percent for capital income. We set $\tau^y = 0.18$ and $\tau^k = 0.29$, slightly above these estimates to reflect the upward trend in fiscal pressure over time. The OECD (2021) reports an income tax wedge of about 17 percent in 2019, while the statutory corporate income tax rate averaged roughly 29 percent between 2005 and 2021 (South African Reserve Bank, 2021). The baseline calibration is therefore consistent with observed fiscal policy.

The model period is one year. Standard values are adopted for production parameters: the capital share is $\alpha = 0.36$ and the depreciation rate of physical capital is $\delta^k = 0.07$. The discount factor is set to $\beta = 0.95$ (Alonso-Ortiz and Rogerson, 2010), implying a steady-state real interest rate of approximately 4.6 percent and a capital-output ratio of 3.4. These values fall within the range observed in South Africa.[4] The parameter governing human capital accumulation is $\varpi = 0.45$ (Trostel, 1993; Zeng and Zhang, 2022). The lower borrowing bound is $\phi = 0$.

The depreciation rate of human capital is set to $\delta^h = 0.06$, consistent with available empirical estimates.[5] Market productivity follows an AR(1) process with persistence $\rho_m = 0.9$ and innovation standard deviation $\sigma_m = 0.227$, following Chang and Fernández (2013); Chang and Kim (2007). There are no direct estimates for home-sector productivity shocks; in the benchmark calibration, we set $\rho_h = 0.9$ and $\sigma_h = 0.227$ and explore alternative values in robustness exercises.

Preference parameters are chosen as follows. The coefficient of relative risk aversion is $\sigma = 2$ (Mohimont, 2022). The labor share in home production is $\xi = 0.6$, consistent with the estimate of 0.57 reported by Bridgman, Duernecker, and Herrendorf (2018). The weight on market consumption in the utility aggregator is set to $\iota = 0.4$, close to the value used by **?**. Empirical evidence suggests that roughly half of total hours are allocated to home production in developing economies, including South Africa (Rubiano Matulevich and Viollaz, 2019). In the benchmark equilibrium, home production accounts for approximately 46 percent of total hours.

Recent empirical work places the elasticity of substitution between home and market goods below unity. Been, Rohwedder, and Hurd (2020) estimate that only about 11 percent of total spending is replaceable by home production in U.S. data. Cossu, Moro, Rodriguez-Roman, and Tunis (2023) estimate an elasticity of approximately 0.29 between time (home goods) and market goods. In line with this evidence, we set $\upsilon = -2.45$ in the benchmark, corresponding to low substitutability, and consider alternative values in sensitivity analysis.

[4] The output-capital ratio in South Africa was 2.8 in 1970, 3.5 in 1993 (its peak), and 2.6 in 2015 (Kumo, 2017).

[5] Blundell, Costa Dias, Meghir, and Shaw (2016) estimate depreciation rates between 6 and 8 percent for the UK; Dinerstein, Megalokonomou, and Yannelis (2022) estimate about 4.3 percent for Greece.

Table 1: Baseline values

Preferences	$\beta = 0.95$; $\sigma = 2$; $\iota = 0.4$; $\upsilon = -2.45$
Production	$\alpha = 0.36$; $\delta^h = 0.06$; $\delta^k = 0.07$; $\varpi = 0.45$; $\xi = 0.6$
Policy	$v = 0.037$; $\tau^k = 0.29$; $\tau^y = 0.18$
Shocks: market	$\rho_m = 0.9$; $\sigma_m = 0.227$
Shocks: home	$\rho_h = 0.9$; $\sigma_h = 0.227$
Credit market	$\phi = 0$

4 Baseline Distribution

Table 2 compares the model-implied cross-sectional distributions of financial wealth, income, and human capital to South African household survey data for 2017. The model reproduces the key qualitative feature of right-skewed wealth and income distributions. In equilibrium, the bottom quintile holds 0.16 percent of financial wealth and 4.5 percent of income, while the top quintile holds approximately 62 percent of wealth and 51 percent of income.

Quantitatively, inequality in the model is lower than in the data. The income Gini in South Africa is about 60 percent, compared to 51 percent in the model. This attenuation is typical of standard Bewley environments, which do not generate sufficiently thick upper tails. Modeling the concentration of wealth, using mechanisms capable of producing heavy-tailed wealth distributions (e.g., preference heterogeneity as in Krusell, Smith, and Jr. 1998), are beyond the scope of this paper.

The model also captures the relatively modest dispersion in human capital observed in the data. The Gini coefficient for educational attainment in South Africa is approximately 17 percent; the model delivers 14 percent. Table 3 reports additional distributional statistics. Market capital is substantially more concentrated (Gini: 63 percent) than home capital (42 percent). Education investment is more unequal (44 percent), despite low human capital inequality, consistent with diminishing returns in human capital accumulation. Inequality in home consumption (27 percent) is lower than in market consumption (31 percent), and dispersion in efficient labor supply – which could also be another proxi to human capital – remains moderate (19 percent).

Table 2: Benchmark Distribution: Model and Data

	Quintile (%)					
	First	**Second**	**Third**	**Fourth**	**Fifth**	**Gini**
MODEL						
Financial Wealth (M)	0.159	2.783	11.160	24.005	61.893	61.283
Income	4.478	9.156	12.876	22.105	51.385	46.490
Human Capital	14.494	15.810	19.231	22.502	27.962	14.339
DATA: SA						
Income	0.097	0.184	0.216	0.230	0.272	16.995
Educ (Yrs)	0.024	0.060	0.097	0.168	0.650	60.128

Table 3: Benchmark Distribution: Education, Market and Home Consumption and Capital

MODEL	Quintile (%)					
	First	**Second**	**Third**	**Fourth**	**Fifth**	**Gini**
Education Inv	5.74	8.80	14.25	21.61	49.60	44.35
Market Cons	7.73	13.24	16.71	23.93	38.39	30.79
Home Cons	8.82	14.34	17.38	23.75	35.70	26.92
Market Capital	0.01	2.03	10.69	23.94	63.32	62.90
Home Capital	4.64	10.51	14.28	23.14	47.43	42.28
Efficient Labour Supply	11.32	16.54	19.20	23.45	29.50	18.71

5 Stochastic Home Production and Substitutability

In a multi-sector consumption environment, households smooth consumption through two margins: precautionary savings and intratemporal reallocation between home and market production. The relative importance of these channels depends on the elasticity of substitution between goods and on sectoral risk.

Table 4 compares three economies: Model 1 (representative agent, complete markets),

Model 2 (heterogeneous agents, deterministic home production), and Model 3 (heterogeneous agents with stochastic home production).

When $\upsilon = 0$ (unit elasticity), Model 2 exhibits higher steady-state savings than Model 1, reflecting precautionary motives under incomplete markets. The equilibrium interest rate is lower and the capital-output ratio is higher. Introducing home-sector risk (Model 3) does not alter aggregate allocations relative to Model 2, except for home consumption. As implied by the intratemporal optimality condition, volatility in home productivity does not affect resource allocation when elasticity is unity.

When goods are substitutes ($\upsilon > 0$, Table 4b), stochastic home production increases precautionary savings. Market capital and labor supply are highest in Model 3. Because goods are substitutable, agents can reallocate production toward the market when home productivity is low. Additional volatility, therefore, strengthens savings incentives and increases market capital accumulation.

When goods are complements ($\upsilon < 0$, Table 4c), the opposite occurs. Home and market shocks reinforce each other, and resource reallocation becomes the primary smoothing device. In Model 3, aggregate market capital and labor are lower than in Model 2. With lower market volatility (Table 5), aggregate capital in the stochastic home economy can even fall below the complete-markets benchmark. Complementarity restricts substitution possibilities, reducing the effectiveness of savings as a smoothing instrument. As a result, stochastic home production combined with complementarity dampens steady-state capital accumulation.

Overall, stochasticity in the home sector increases (decreases) steady-state savings and market labor when goods are substitutes (complements). The limited movement in interest rates across incomplete-market economies indicates that intratemporal reallocation plays a quantitatively important role when $\upsilon \neq 0$.

6 Fiscal Policy

Table 6 reports the steady-state effects of a 5 percentage-point increase in the income tax rate. Under incomplete markets (Models 2 and 3), the reform reduces most macroeconomic aggregates across all elasticity values.[6] Market capital and education investment decline by roughly 13 − 18 percent, and market consumption falls by 6 − 13 percent. Home labor increases as households substitute away from taxed market activities toward -

Table 4: Aggregate comparison between models

Aggregate variables	**Model 1**	**Model 2**	**Model 3**
Table 4a: upsilon = 0			
Interest rate	0.117	0.047	0.047
Education investment	0.191	0.326	0.326
Market consumption	0.344	0.400	0.400
Home labour	0.358	0.335	0.335
Home consumption	0.218	0.240	0.050
Market labour	0.642	0.665	0.665
Market capital	1.921	4.226	4.226
Human capital	3.187	3.675	3.675
Market efficient labour	2.046	3.053	3.053
Home capital	0.180	0.232	0.232
Table 4b: upsilon = 0.5			
Interest rate	0.117	0.047	0.047
Education investment	0.191	0.337	0.328
Market consumption	0.344	0.546	0.857
Home labour	0.358	0.300	0.123
Home consumption	0.218	0.200	0.016
Market labour	0.642	0.700	0.877
Market capital	1.921	4.536	5.541
Human capital	3.187	3.691	3.632
Market efficient labour	2.046	3.263	4.010
Home capital	0.180	0.178	0.062
Table 4c: upsilon = -2.45			
Interest rate	0.117	0.047	0.047
Education investment	0.191	0.317	0.322
Market consumption	0.344	0.308	0.127
Home labour	0.358	0.359	0.457
Home consumption	0.218	0.267	0.070
Market labour	0.642	0.641	0.543
Market capital	1.921	4.032	3.424

Human capital	3.187	3.658	3.657
Market efficient labour	2.046	2.904	2.462
Home capital	0.180	0.268	0.332

Note: Model 1 – Representative agent model; Model 2 – Heterogeneous agent model with non-stochastic home production; Model 3 – Heterogeneous agents model with stochastic home production.

Table 5: Aggregate comparison between models, smaller shocks: υ = -2.45; σ_m = 0.14

Aggregate variables	**Model 1**	**Model 2**	**Model 3**
Interest rate	0.117	0.069	0.070
Education investment	0.191	0.184	0.185
Market consumption	0.344	0.228	0.096
Home labour	0.358	0.366	0.470
Home consumption	0.218	0.207	0.055
Market labour	0.642	0.634	0.530
Market capital	1.921	2.199	1.821
Human capital	3.187	3.043	3.042
Market efficient labour	2.046	2.088	1.740
Home capital	0.180	0.169	0.214

Note: Model 1 – Representative agent model; Model 2 – Heterogeneous agent model with non-stochastic home production; Model 3 – Heterogeneous agents model with stochastic home production.

untaxed home production. Nevertheless, home consumption typically declines because total productive capacity contracts.

The magnitude of these responses depends on substitutability. When goods are complements (low elasticity), substitution possibilities are limited; home labor rises modestly and both home capital and home consumption fall more sharply. As elasticity increases, households reallocate more aggressively toward home production, mitigating the decline in home consumption. Greater substitutability, therefore, provides a partial buffer against income losses under incomplete markets.

Under complete markets (Model 1), steady-state market capital and efficient labor remain unchanged because prices are unaffected when growth is fixed. Human capital declines, and market labor adjusts one-for-one, leaving effective labor unchanged. Consumption composition shifts but aggregate capital-output ratios remain constant.

Distributionally, the tax increase raises inequality in market capital by about 3−4 percent (Table 7), while reducing inequality in income, consumption, and human capital. Table 8 shows that the bottom 60 percent increase their share of home capital, while the top 40 percent increase their share of market capital. Transfers reduce precautionary savings among lower-income households and lower their market labor supply. At the same time, higher-income households reduce education investment, contributing to a modest decline in human capital inequality.

Taken together, the results indicate that higher income taxation primarily depresses phys-

Table 6: Aggregate effects of a 5 ppt increase in income tax

Aggregate variables	**% Change** **Model 1**	**Model 2**	**Model 3**
Table 5a: upsilon = 0			
Interest rate	0.000	0.390	0.390
Education investment	-11.439	-14.643	-14.643
Market consumption	15.055	-10.020	-10.020
Home labour	-9.948	7.661	7.661
Home consumption	-17.612	-3.900	-3.900
Total consumption	-4.545	-6.343	-6.343
Market labour	5.147	-4.086	-4.086
Market capital	0.000	-15.821	-15.821
Human capital	-5.147	-6.763	-6.763
Market efficient labour	0.000	-10.552	-10.552
Home capital	-21.387	-10.291	-10.291
Table 5b: upsilon = 0.5			
Interest rate	0.000	0.480	0.395
Education investment	-11.439	-14.025	-17.244
Market consumption	15.055	-12.876	-9.709
Home labour	-9.948	7.921	10.827
Home consumption	-17.612	-1.240	2.141
Total consumption	-2.065	-7.270	-7.735
Market labour	5.147	-3.596	-1.623
Market capital	0.000	-16.136	-12.861
Human capital	-5.147	-5.757	-5.805
Market efficient labour	0.000	-9.584	-7.505
Home capital	-21.387	-7.416	-4.011
Table 5c: upsilon = -2.45			
Interest rate	0.000	0.422	0.540
Education investment	-11.439	-14.633	-12.862
Market consumption	15.055	-7.159	-6.422
Home labour	-9.948	6.150	5.467
Home consumption	-17.612	-5.444	-4.593
Total consumption	-13.362	-6.003	-4.852
Market labour	5.147	-3.618	-4.849
Market capital	0.000	-15.627	-17.706

Human capital	-5.147	-6.739	-5.529
Market efficient labour	0.000	-10.000	-10.428
Home capital	-21.387	-11.715	-11.362

Note: Model 1 – Representative agent model; Model 2 – Heterogeneous agent model with non-stochastic home production; Model 3 – Heterogeneous agents model with stochastic home production.

physical and human capital accumulation. The extent to which households smooth consumption depends critically on market incompleteness and on the elasticity of substitution between home and market goods.

Table 7: Inequality effects of a 5 ppt increase in income tax

% Change (Gini)			
	$\upsilon = 0$	$\upsilon = 0.5$	$\upsilon = -2.45$
Market consumption	-1.786	-1.627	-1.477
Home consumption	-1.335	-0.523	-1.347
Total consumption	-1.690	-1.897	-1.342
Wage income	-1.880	-2.809	-2.741
Human capital	-1.280	-2.153	-1.297
Home Capital	-1.787	-1.319	-1.531
Market Capital	3.856	4.019	3.434

Table 8: Distributional effects of a 5 ppt increase in income tax(υ = -2.45)

	Quintile						
Baseline	**1st**	**2nd**	**3rd**	**4th**	**5th**	**Gini**	**P2080**
Education investment	5.738	8.803	14.252	21.611	49.596	44.353	8.643
% pts	1.013	0.627	-0.046	-1.996	0.402	-1.402	-1.237
Home labour	13.657	16.811	19.025	20.966	29.540	15.350	2.163
% pts	0.527	0.016	-0.235	-0.090	-0.219	-0.601	-0.096
Market labour	11.965	19.186	20.821	22.686	25.342	12.928	2.118
% pts	-0.669	-0.005	0.308	0.277	0.088	0.844	0.133
Home capital	4.637	10.513	14.283	23.138	47.429	42.276	10.228
% pts	0.344	0.566	0.142	-0.019	-1.034	-1.531	-0.914
Market capital	0.013	2.031	10.694	23.941	63.321	62.901	
% pts	-0.013	-1.460	-1.777	0.344	2.906	3.434	

7 Conclusion

This paper develops a heterogeneous-agent incomplete-markets model that incorporates stochastic home production and endogenous human capital investment. By allowing households to face idiosyncratic shocks in both market productivity and home production, and by introducing complementarity between home and market goods, the framework alters a central implication of standard Bewley-type models. In particular, when home and market goods are complements and home production is risky, households smooth consumption primarily through intratemporal reallocation rather than precautionary saving. As a result, equilibrium market capitalisation can be lower than in the canonical incomplete- markets benchmark, mitigating the counterfactual over-accumulation of capital that often arises when such models are applied to developing economies.

The model is calibrated to South Africa, an economy characterized by high inequality, elevated unemployment, and persistently weak growth. Within this environment, fiscal policy has sizable macroeconomic and distributional effects. An increase in distortionary income taxation reduces aggregate savings, physical capital accumulation, output, and human capital investment. These efficiency losses reflect both reduced after-tax returns and weaker incentives for market participation and investment. At the same time, higher taxes lower income and consumption inequality, largely through the insurance role of transfers.

The distributional effects, however, are multidimensional. Greater reliance on trans- fers reduces precautionary savings among lower-income households, while higher-income households adjust investment and portfolio decisions differently. As a result, wealth inequality can increase even as income and consumption inequality decline. These findings highlight a key tension: policies that enhance redistribution and reduce short-run inequality may simultaneously dampen capital formation and alter the composition of wealth holdings across households.

More broadly, the results underscore the importance of modeling multi-sector risk and household production when evaluating fiscal policy in emerging and developing economies. In environments where households can smooth shocks not only through savings but also through time reallocation across sectors, the elasticity of substitution between home and market goods becomes a central determinant of aggregate outcomes. The framework developed here provides a quantitative tool for analyzing fiscal reforms in developing economies where incomplete markets, sectoral production risk, and human capital dynamics jointly shape macroeconomic performance and inequality.

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