Rural-Urban Migration and the Intergenerational Transmission of Wealth

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ABSTRACT

This paper extends the literature on poverty traps and regional economics by incorporating rural-urban migration, human capital externalities, and regional agglomeration effects into Galor and Zeira's (1993) overlapping generations model to examine the welfare impacts of various person-based and place-based policies. We formalize the conditions that may induce a rural brain-drain. The model is calibrated and simulated to demonstrate how regions with different production and housing technologies may respond differently to a given policy. Our results show that for certain parameter values, well intended policies targeting poor households may instead worsen their long-run welfare outcomes if households prefer not to migrate to the wealthier urban region when awarded an education subsidy. In other cases, person-based policies are shown to improve the long-run welfare of poorer households by facilitating migration to the city. Place-based policies that enhance rural firm productivity without targeting individual households may yield higher average welfare for rural residents. In some instances, the benefits of place-based policies may not trickle down to less wealthier households, whereas in other cases, they are more effective than the subsidy program in improving the welfare of the poorest.

Keywords: Overlapping Generations Model, Rural-Urban Migration, Poverty Traps, Agglomeration Economies, Place-based Policies, Person-based Policies.

JEL Classification: *R13, R58, O15*

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Introduction

In addition to estimating the immediate welfare impacts of policy designed to reduce rural poverty, it is important to assess changes in the dynamics of welfare resulting from its implementation. Arguably, some of the greatest gains to society of such policies are realized through benefits that accrue through intergenerational linkages (Partridge and Rickman, 2006). Revised estimates of intergenerational income elasticities in the US reveal that mobility between income classes may be lower than previously assumed (Solon, 1992; Mazumdar, 2005; Charles and Hurst, 2003). This implies that financial constraints faced by a child's family may have serious repercussions to his/her earnings capacity as an adult. Effective policy may stem the persistence of poverty by translating current gains to future generations that may also be self-reinforcing over time.

The further a rural town is situated from its nearest urban core, the more it is penalized in terms of poverty rates (Partridge and Rickman, 2008). Policies designed to improve local labor market conditions or raise educational attainment levels will shift labor demand and supply. Moreover, these policies contribute to welfare differentials between regions, and, since people vote with their feet, may spur migration out of the rural region. The redistribution of human capital leads to further adjustments in wages, which, through intergenerational linkages, alters future local labor supply as well. Yet, these adjustments may have particularly adverse consequences on the remaining residents of rural areas if the migration leads to a 'brain drain' that reduces the productivity of the remaining workers. Thus, migration and informational spillovers between regions thereby create a nexus between the spatial distribution of economic activity and the evolution of regional welfare over time.

Whether a person-based policy is more effective than a place based policy in alleviating poverty depends, to a great extent, on the region's characteristics. Every place has unique characteristics that preclude spatially uniform responses to a given policy. The current debate between person and place bases policies illustrates that both types of policies have their merits as well as drawbacks. Person based policies, such as education subsidies direct benefits to those that are disadvantaged but may be very expensive and induce migration of the most able workers if there aren't sufficient employment opportunities locally (Blank, 2005; Partridge and Rickman, 2006), thereby undermining a possible rationale for their implementation. Place-based policies have the advantage of improving the economic vitality of the region and increasing job opportunities but the benefits may not be captured by poorest (Kraybill and Kilkenny, 2003; Partridge and Rickman, 2006).

This paper demonstrates how the interaction between a rural region and a vibrant city affects the evolution of welfare over time. We extend Galor and Zeira's (1993) overlapping generations model to examine how various centripetal and centrifugal forces spur or deter rural-to-urban migration of skilled workers. Higher regional wages serve as a centripetal force, attracting workers into the region, whereas higher housing prices and congestion serve as a centrifugal force. The model focuses on the mechanism by which migration affects the intergenerational transmission of wealth in the rural region. We simulate the model under different initial conditions for housing and goods production technologies and observe how person-based policies fare verses place-based policies in reducing poverty and improving welfare.

The Model

Previous migration models in the economic geography literature have stressed Marshallian externalities and agglomeration economies with homogenous households and a fixed number of skilled workers (Fujita and Thisse, 2002 and Helpman, 1998). Conversely, this model assumes barriers to migration, an unequal distribution of wealth, credit constraints, and fixed costs of human capital accumulation, thereby endogenizing investments in skill formation. The decision of households to invest in human capital and migrate will depend on the wealth inherited from their forefathers, which in turn, determines the return to investment and migration for subsequent generations.

The indivisibility of human capital investments and credit constraints causes nonlinearities in the intergenerational dynamics of wealth, generating multiple steady states. The unstable steady state, a counterpart of the Micawber threshold in the asset dynamics literature (Carter and Barrett, 2006), is the level of wealth above which families gravitate towards a higher level of welfare, and below which they spiral down into a poverty trap. Allowing for migration between regions, though at a cost, shifts these steady states by magnitudes depending on the change in rural and urban labor productivity. If diminishing returns to skilled labor are strong and outweigh the effect of knowledge spillovers, then the outflow of skilled workers from the rural region may lead to a rise in wages and a net welfare increase for the remaining residents. On the other hand migration can produce vicious cycles if wages in the region experiencing the brain drain decrease because there are fewer complementary skilled workers. These dynamics may give skilled workers even less of an incentive to stay, leading to further reduction in wages due to the depletion of the stock of human capital.

To put this theory in perspective, Baumann and Reagan (2005) find that the probability of college graduates migrating out of the Appalachian region, which has some of the highest poverty rates in the United States, is 17%, while the probability for non-Appalachian college graduates migrating into the region is only 1.2%. The gap in the return to education between Appalachia and the rest of the country increases with education, therefore, college graduates face a higher opportunity cost of staying than low-skilled workers who prefer the lower costs of living in Appalachia. The incentive for college students to migrate is compounded by Appalachia's close proximity to several growing urban areas such as Atlanta, Nashville, and Washington, D.C. that provide economic opportunities at relatively low migration and psychic costs (Baumann and Reagan, 2005). The out-migration of skilled workers likely facilitates the persistence of poverty in the region. The following model formalizes the impact of migration on welfare outcomes and provides a framework to predict under which conditions the source region will benefit from migration or adversely, experience a brain drain, as that experienced by Appalachia and other poor regions of the world.

The Framework

In every generation, households live for two periods and allocate their wealth between bequests to their children and the consumption of housing and a homogenous good. Housing production is determined by a constant elasticity of scale (CES) production function that uses land and physical capital as inputs. The homogenous good is produced

in both the city and rural region by a perfectly competitive skilled sector that uses human capital in addition to physical capital and land. The product is traded freely between regions without any transportation costs, therefore, its price is normalized to unity and wages are equated to the marginal product of labor.

In order to join the skilled labor pool, workers are required to invest in human capital by incurring a fixed cost of education, *h*. If they choose not to invest in human capital they obtain their reservation or unskilled wage, $w_{n,r}$, which is constant across households and time. Skilled workers have the option to migrate to the city by incurring an additional fixed cost, *c*. Further, we assume that unskilled workers are immobile.

Physical capital is perfectly mobile so that individuals and firms have access to international capital markets where the world interest rate, *r*, is assumed to be constant over time. Household credit constraints arise from costly monitoring of borrowers by lenders, thereby making the interest rate for individual borrowers, *i*, higher than *r*. Since each of the two periods in an agent's lifetime cover a span of perhaps 20-30 years, the interest rate *i*, and rate of return, *r* would have the units of "percent per generation" and may well exceed unity (Becker and Tomes, 1979). Due to the presence of such credit constraints and fixed costs of human capital and migration, households that differ in the amount of received bequests will differ in their choices.

Household Preferences

Since we are concerned with the impact of rural-to-urban migration on the source region, we only consider allocation decisions made by rural households. Urban households are assumed to have already settled into their steady states and therefore there is no mobility between workers in the skilled and unskilled sectors in the city. Yet, the level of urban welfare will change when migration from the rural region occurs.

There are two periods in a household's lifetime. In the first period, a household of generation *t* inherits an amount $b_{i,t}$ and chooses whether to devote their time to education or instead work in the unskilled sector. If the household chooses to invest in human capital they also decide whether to stay in the rural region or migrate to the city. In the second period all households work, receive wages, and allocate wealth, $x_{i,t}$, between housing, the product, and bequests to their children. For simplicity, following Galor and Zeira (1993), consumption only occurs in the second period.

The utility function of household *i* of generation *t* is

$$U_{i,t} = \alpha \log(c_{i,t}) + \beta \log(l_{i,t}) + (1-\alpha-\beta)\log(b_{i,t+1})$$

where $c_{i,t}$, $l_{i,t}$ are the consumption levels of the homogenous good and housing respectively, $b_{i,t+1}$ is the bequest given to their child born to generation *t+1*, and $0 \le \alpha, \beta < 1$. Household wealth, $x_{i,t}$ is allocated according to the following optimized rules:

$$c_{i,t} = \alpha x_{i,t}$$
$$l_{i,t} p_{j,t} = \beta x_{i,t}$$
$$b_{i,t+1} = (1-\alpha-\beta) x_{i,t}$$

where $p_{j,t}$ is the price of housing at time t in region j=r,u (r=rural, u=urban). Their indirect utility is therefore:

$$U_{i,t} = \upsilon + \log(\frac{x_{i,t}}{p_{j,t}^{\beta}})$$

$$\upsilon = \alpha \log(\alpha) + \beta \log(\beta) + (1-\alpha-\beta)\log(1-\alpha-\beta)$$

Production Technology of the Homogenous Consumption Good

Following Henderson and Wang (2005), the model allows for knowledge spillovers in production in both the rural and urban region. However, a key difference in city production is the existence of an agglomeration component, which is represented by a population term in Henderson and Wang's urban production function. The population in the city is assumed to be above a critical mass required to generate urbanization economies, whereas the population in the rural region is not yet at the mark.

The production function in the rural and urban goods sectors, $Y_{r,t}^{g}$ and $Y_{u,t}^{g}$, at time t are

$$Y_{r,t}^{g} = (H_{r,t} + H_{u,t}^{\eta})^{\delta_r} H_{r,t}^{\gamma} \left(N_{r,t}^{g}\right)^{\varepsilon} \left(K_{r,t}^{g}\right)^{1-\gamma-\varepsilon}$$
$$Y_{u,t}^{g} = n^{\sigma} (H_{r,t}^{\eta} + H_{u,t})^{\delta_u} H_{u,t}^{\gamma} \left(N_{u,t}^{g}\right)^{\varepsilon} \left(K_{u,t}^{g}\right)^{1-\gamma-\varepsilon}$$

$H_{r,t}, N_{r,t}^{g}, K_{r,t}^{g}$, and $H_{u,t}, N_{u,t}^{g}, K_{u,t}^{g}$ are the aggregate stocks of human capital, land, and physical capital in the goods sector of the rural region and city respectively.. Knowledge capital in each region is determined by the interaction among *all* skilled workers in both regions, but the intensity of these interactions, denoted by η $(0 \le \eta \le 1)$ varies with the spatial distribution of these workers. (Fujita and Thisse, 2002). $\delta_r, \delta_u, \gamma, \varepsilon$ are between 0 and 1. n is the population in the city and σ <1 is the agglomeration parameter. Rural and urban wages are given by

$$w_{r,t} = (\delta_r (H_{r,t} + H_{u,t}^{\eta})^{\delta r-1} H_{r,t}^{\gamma} + \phi H_{r,t}^{\gamma-1} (H_{r,t} + H_{u,t}^{\eta})^{\delta r}) \left(N_{r,t}^{g}\right)^{\varepsilon} \left(K_{r,t}^{g}\right)^{1-\gamma-\varepsilon} \quad (1)$$

$$w_{u,t} = n^{\sigma} (\delta_u (H_{r,t}^{\eta} + H_{u,t})^{\delta u-1} H_{u,t}^{\gamma} + \phi H_{u,t}^{\gamma-1} (H_{r,t}^{\eta} + H_{u,t})^{\delta u}) \left(N_{u,t}^{g}\right)^{\varepsilon} \left(K_{u,t}^{g}\right)^{1-\gamma-\varepsilon} \quad (2)$$

Dispersive Forces and Housing Production Technology

There are different ways to incorporate dispersive forces into a model with Marshallian externalities. For example, Fujita and Thisse (2002) include the population and population density of the region in the household's indirect utility function. The population of a region is assumed to act as a centripetal force that attracts workers, whereas the population density, a centrifugal force, has a negative impact on indirect utility due to crowding out effects arising from higher pollution and crime rates etc.

Elhanan Helpman (1998), instead, invokes the scarcity of land, which is divided equally among residents, as a centrifugal force. An influx of migrants into the region lowers the welfare by reducing the share of land available to each resident.

In this model, higher housing prices serve as a 'push' factor. The production of housing, $Y_{j,t}^{h}$,is given by the following CES function

$$Y_{j,t}^{h} = A(\theta\left(K_{j,t}^{h}\right)^{\phi} + (1-\theta)\left(N_{j,t}^{h}\right)^{\phi})^{1/\phi}$$

where $K_{j,t}^{h}$ and $N_{j,t}^{h}$ are the regional stocks of physical capital and land used in construction. We assume the total amount of available land, $\bar{N}_{j}$, in the city and rural region are fixed and divided between goods and housing production. Therefore $N_{j,t}^{h} = \bar{N}_{j} - N_{j,t}^{g}$. Further, we assume that the quantity of land in the city is roughly one-tenth of that in its rural fringe.

The price of housing is then derived by equating aggregate housing demand by households to aggregate housing supply in the rural and urban regions respectively.

$$p_{r,t}A(\theta\left(K_{r,t}^{h}\right)^{\phi} + (1-\theta)\left(N_{r,t}^{h}\right)^{\phi})^{1/\phi} = \beta X_{r,t} \qquad (3)$$

$$p_{u,t}A(\theta\left(K_{u,t}^{h}\right)^{\phi} + (1-\theta)\left(N_{u,t}^{h}\right)^{\phi})^{1/\phi} = \beta X_{u,t} \qquad (4)$$

where $X_{j,t}$ is the aggregate wealth of residents in region $j=r,u$.

ϕ is the CES parameter and is equal to s/s-1, where s is the elasticity of substitution between land and physical capital. In the city, where land is scare, the sensitivity of housing prices to an influx of population will depend on the CES parameter. Indeed, housing prices will rise with in-migration. However the strong upward pressure on urban prices can be contained if land is easily substitutable for cheaper physical capital in construction.

Household Decisions

Labor supply is determined through a discontinuous optimization process. Since households are heterogeneous in terms of their inheritance, their occupational and locational decisions will vary according to the bequest they receive. As mentioned above, if they choose to work as skilled labor, they must incur a fixed cost of investment in human capital, *h*, and an additional fixed migration cost, *c*, if they choose to migrate as well.

Households compare their indirect utilities from different options and choose the course of action that derives the greatest utility. If a household chooses to work as a low-skilled worker, their first period wealth is $(w_{n,r} + b_{i,t})(1+r)$, and their second period earnings is just $w_{n,r}$. Therefore their lifetime indirect utility is:

$$U_{i,t} = \log[\frac{(w_{n,r} + b_{i,t})(1+r) + w_{n,r}}{p_{r,t}^{\beta}}] + \varepsilon .$$

If an household chooses to borrow funds to supplement their bequest for investing in human capital, then their first period debt is $(h - b_{i,t})(1+i)$, where i is the borrowers interest rate (i>r), and their second period earnings are $w_{r,t}$. Their total lifetime utility would then be:

$$U_{i,t} = \log[\frac{(b_{i,t} - h)(1+i) + w_{r,t}}{p_{r,t}^{\beta}}] + \varepsilon .$$

Likewise the utility of a household who can afford to invest in human capital without borrowing but chooses not to migrate is:

$$U_{i,t} = \log[\frac{(b_{i,t} - h)(1+r) + w_{r,t}}{p_{r,t}^{\beta}}] + \varepsilon .$$

The utility of an household who chooses to borrow to invest in human capital and migrate to the city is:

$$U_{i,t} = \log[\frac{(b_{i,t} - (h+c))(1+i) + w_{u,t}}{p_{u,t}^{\beta}}] + \varepsilon ,$$

and those who find it preferable to invest in human capital and migrate without having to borrow will have utility:

$$U_{i,t} = \log[\frac{(b_{i,t} - (h+c))(1+r) + w_{s,u,t}}{p_{u,t}^{\beta}}] + \varepsilon$$

Household decisions differ because of the wedge between the borrowers interest rate, *i*, and the rate of return on wealth, *r*. As stated above, choices will depend on their inheritance, $b_{i,t}$.

Equilibrium

Equilibrium skilled wages, housing prices and factor quantities are simultaneously determined each generation under full employment of workers and factors. Households are assumed to have perfect foresight, implying that their decision to invest in human capital or migrate in the first period of their lives will be consistent with wage and price realizations in the second period. Equations (1) and (2) satisfy labor market equilibrium conditions

when $H_{r,t}$ and $H_{u,t}$ are the aggregate stocks of human capital derived from household utility maximization. Equations (3) and (4) satisfy housing demand and supply conditions in both regions.

The quantities of physical capital employed in the goods and housing sectors in the city are determined by equating the marginal product of physical capital to the global interest rate, *r*.

$$r = \frac{\varepsilon}{K_{u,t}^{g}} n^{\sigma} (H_{r,t}^{\eta} + H_{u,t})^{\delta_u} H_{u,t}^{\gamma} \left(N_{u,t}^{g}\right)^{\varepsilon} \left(K_{u,t}^{g}\right)^{1-\gamma-\varepsilon} \tag{5}$$

$$r = \frac{p_{u,t} A\theta}{\left(K_{u,t}^{h}\right)^{1-\phi}} (\theta \left(K_{u,t}^{h}\right)^{\phi} + (1-\theta)\left(N_{u,t}^{h}\right)^{\phi})^{1/\phi} \tag{6}$$

We assume that physical capital is more expensive to acquire in the rural region due to informational constraints in conjunction with a higher level of risk in thinner rural markets. In this case, rural marginal products are equated to $r + \xi$, where $\xi > 0$.

$$r + \xi = \frac{\varepsilon}{K_{r,t}^{g}} (H_{r} + H_{u}^{\eta})^{\delta_r} H_{r,g}^{\gamma} \left(N_{r,t}^{g}\right)^{\varepsilon} \left(K_{r,t}^{g}\right)^{1-\gamma-\varepsilon} \tag{7}$$

$$r + \xi = \frac{p_{r,t} A\theta}{\left(K_{r,t}^{h}\right)^{1-\phi}} \left(\theta \left(K_{r,t}^{h}\right)^{\phi} + (1-\theta)\left(N_{r,t}^{h}\right)^{\phi}\right)^{1/\phi} \tag{8}$$

Finally, land factors prices are equalized across the goods and housing sectors in the rural and urban regions respectively:

$$\frac{(1-\gamma-\varepsilon)}{N_{r,t}^{g}} (H_{r,t} + H_{u,t}^{\eta})^{\delta_r} H_{r,t}^{\gamma} \left(N_{r,t}^{g}\right)^{\varepsilon} \left(K_{r,t}^{g}\right)^{1-\gamma-\varepsilon} = \frac{p_{r,t} A(1-\theta)}{(\overline{N}_r - N_{r,t}^{g})^{1-\phi}} \left(\left(K_{r,t}^{h}\right)^{\phi} \theta + (1-\theta)\left(\overline{N}_r - N_{r,t}^{g}\right)^{\phi}\right)^{1/\phi} \tag{9}$$

$$\frac{(1-\gamma-\varepsilon)}{N_{u,t}^{g}} (H_{r}^{\eta} + H_{u})^{\delta_u} H_{u,t}^{\gamma} \left(N_{u,t}^{g}\right)^{\varepsilon} \left(K_{u,t}^{g}\right)^{1-\gamma-\varepsilon} = \frac{p_{u,t} A(1-\theta)}{(\overline{N}_u - N_{u,t}^{g})^{1-\phi}} \left(\theta \left(K_{u,t}^{h}\right)^{\phi} + (1-\theta)\left(\overline{N}_u - N_{u,t}^{g}\right)^{\phi}\right)^{1/\phi} \tag{10}$$

These ten equations characterize regional equilibrium conditions for each generation, *t.*

When does migration take place?

Prevailing wage and price conditions determine whether skilled workers migrate. When real urban wages aren't high enough to cause a complete brain drain in the rural region, rural-urban migrants include workers from the two cohorts of the wealth distribution. At the upper end of the distribution , inheritors of bequests greater than the cost of education, *h*, may find it cheaper to migrate, regardless of whether they need to borrow or not. At the other end of the wealth spectrum, a portion of the poorest workers who have bequest levels less than *h*, may choose to incur debt to migrate to the city. The real value of their liabilities is drawn down by higher housing prices in the city, and is more than compensated for by higher urban wages. In contrast, middle-income rural residents will

derive greater welfare surpluses if they choose not to incur the cost of migration which their richer neighbors can afford to do. They are better off taking advantage of lower rural housing prices since their initial liabilities are not as great as some of their poorer neighbors.

Richer rural residents, with bequests higher than *h* will choose to migrate if the following condition is satisfied

$$\frac{w_{s,r,t}}{p_{l,r,t}^{\beta}} + \frac{c(1+r)}{p_{l,r,t}^{\beta}} < \frac{w_{s,u,t}}{p_{l,u,t}^{\beta}} \qquad \text{(A)}$$

This inequality implies that the opportunity cost of migration for savers is less than the gains from migration. The left hand side is the sum of real rural wages plus the returns from not incurring the cost of migration and instead investing it in savings. The right hand side is real urban wages. Note that this inequality only presents the opportunity cost for rural residents with bequests above *h*, and does not imply that some less wealthier households will migrate as well. In that case, if the following condition is satisfied, households with bequests less than *h* choose to migrate.

$$\pi\left(\frac{w_{nr} + h(1+r)}{{p_{r,t}}^{\beta}} - \frac{w_{u,t} - c(1+i)}{{p_{u,t}}^{\beta}}\right) < \left(\frac{w_{u,t} - c(1+i)}{{p_{u,t}}^{\beta}} - \frac{w_{r,t}}{{p_{r,t}}^{\beta}}\right) \qquad \text{(B)}$$

where $\pi = \frac{(1+i)({p_{u,t}}^{\beta} - {p_{r,t}}^{\beta})}{(1+i){p_{r,t}}^{\beta} - (1+r){p_{u,t}}^{\beta}}$. The left hand side of the inequality is the relative gains of choosing the unskilled sector over migration to the city. The right hand side is the relative gains of migration over choosing the skilled rural sector. As long as the relative benefits of unskilled wages are smaller than the premium from migration, some workers with bequests less than *h* will choose to migrate.

When does a brain drain occur?

The section above described the conditions under which migration may occur, though not all skilled residents will migrate under those conditions. A widespread brain drain occurs only under the following condition

$$\frac{w_{s,r,t}}{p_{l,r,t}^{\beta}} + \frac{c(1+i)}{p_{l,u,t}^{\beta}} < \frac{w_{s,u,t}}{p_{l,u,t}^{\beta}} \qquad \text{(C)}$$

The left hand side of this condition is the cost of migration, which includes the opportunity cost of foregone rural wages and the real financial cost of migration for borrowers (i.e., the difference between equations A and C is that A uses *r* or the returns from savings, while (C) uses *i*). If the sum of these components, i.e. the total cost of migration, is less than real urban wages, then everyone who finds it profitable to invest in human capital will find it profitable to invest in human capital and migrate, borrowers and savers alike. Note that in this case, regardless of their bequest levels, all skilled rural residents will choose to migrate.

When is a brain drain averted?

Migration ceases or does not take place when conditions (A) and (B) are reversed. This implies that residents who received bequests more as well as less than *h* will not find it profitable to migrate. Poorer households, in this case benefit more from either settling for the unskilled wage or investing in education to the join the rural skilled sector. Regional real wage differentials aren't high enough to induce richer rural residents to migrate either.

Bequest thresholds

For each of the above cases, we calculate threshold levels of bequests at which households are indifferent between two choices. Table 1 shows the ranges of bequests for each type of household decision when conditions (A) and (B) hold, i.e. when some migration takes place. Table 2 shows bequest ranges when condition (C) holds, i.e. when a brain drain occurs, and table 3 when conditions (A) and (B) do not hold or when migration ceases.

Bequest intervals when some migration takes place (A) and (B) hold.	*Household Decision*
$b_{i,t} < o = \frac{1}{(1+i)\,p_{r,t}{}^{\beta} - (1+r)\,p_{u,t}{}^{\beta}}\left(w_{nr}\,p_{u,t}{}^{\beta} + (h+c)(1+i)\,p_{r,t}{}^{\beta} - w_{u,t}\,p_{r,t}{}^{\beta}\right)$	Work as unskilled labor in the rural region
$o \le b_{i,t} < \ q = h + \frac{1}{(1+i)(\,p_{u,t}{}^{\beta} - p_{r,t}{}^{\beta})}\left(w_{u,t}\,p_{r,t}{}^{\beta} - c(1+i)\,p_{r,t}{}^{\beta} - w_{r,t}\,p_{u,t}{}^{\beta}\right)$	Borrow to invest in human capital and migrate to the city
$q \le b_{i,t} < h$	Borrow to invest in human capital and work in the rural skilled sector
$h \le b_{i,t} < s = h + \frac{1}{(1+i)\,p_{r,t}^{\beta} - (1+r)\,p_{u,t}^{\beta}}[w_{r,t}\,p_{u,t}^{\beta} + (c(1+i) - w_{u,t})\,p_{r,t}^{\beta}]$	Invest in human capital and stay in the rural region without having to borrow
$s \le \ b_{i,t} < h+c$	Borrow to invest in human capital and migrate to the city
$h+c \le \ b_{i,t} < z = \ h + \frac{1}{(1+r)[\,p_{u,t}^{\beta} - p_{r,t}^{\beta}]}[(w_{u,t} - c(1+r))\,p_{r,t}^{\beta} - w_{r,t}\,p_{u,t}^{\beta}]$	Invest in human capital and migrate to the city without having to borrow
$z < b_{i,t}$	Invest in human capital and stay in the rural region without having to borrow

Table 1

Bequest intervals when a brain drain occurs (C) holds.	*Household Decision*
$b_{i,t} < o = \frac{1}{(1+i)\,p_{r,t}{}^{\beta} - (1+r)\,p_{u,t}{}^{\beta}}\left(w_{nr}\,p_{u,t}{}^{\beta} + (h+c)(1+i)\,p_{r,t}{}^{\beta} - w_{u,t}\,p_{r,t}{}^{\beta}\right)$	Work as unskilled labor in the rural region
$o \le b_{i,t} < h+c$	Borrow to invest in human capital and migrate to the city
$b_{i,t} \ge h+c$	Invest in human capital and migrate to the city without having to borrow

Table 2

Bequest intervals when a brain drain is averted (A) and (B) do not hold.	*Household Decision*
$b_{i,t} < f = \frac{1}{i-r}[w_{n,r}(2+r) + h(1+i) - w_{s,r,t}]$	Work as unskilled labor in the rural region
$f \le b_{i,t} < h$	Borrow to invest in human capital and migrate to the city
$b_{i,t} \ge h+c$	Invest in human capital and migrate to the city without having to borrow

Table 3

Dynamics of Bequests

The optimal allocation of wealth towards bequests was derived above as $b_{i,t+1} = (1-\alpha-\beta)x_{i,t}$. Figure 1 shows the evolution of real bequests, with $\frac{b_{i,t+1}}{p_{j,t+1}^{\beta}}$ plotted against $\frac{b_{i,t}}{p_{j,t}^{\beta}}$ when migration takes place, i.e. when conditions (A) and (B) hold.

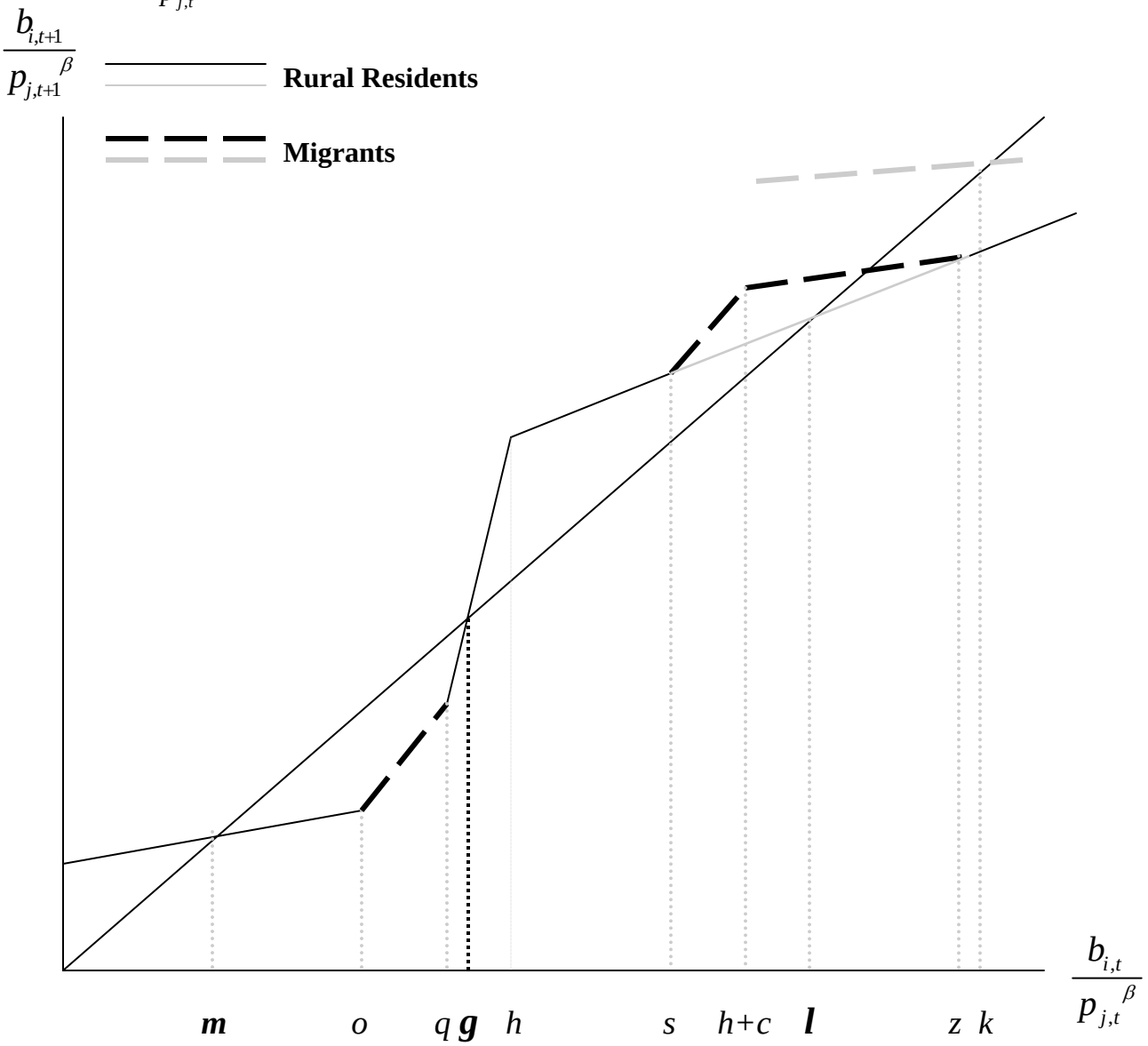


Figure 1

m, *l* and *k* are stable steady states, while *g* is an unstable steady state. For example, if the initial bequest level falls below *m*, the amount of transfers passed down from generation to generation will increase until it eventually converges to *m*, while transfers received by children with forefathers who had bequest levels above *m* but below *g* will decrease until it too converges to *m.*

$$m = \frac{1-\alpha-\beta}{1-(1-\alpha-\beta)(1+r)} w_{n,r}(2+r)$$

$$g = \frac{1-\alpha-\beta}{(1-\alpha-\beta)(1+i)-1}(h(1+i)-w_{r,t})$$

$$l = \frac{1-\alpha-\beta}{1-(1-\alpha-\beta)(1+r)}(w_{r,t}-h(1+r))$$

$$k = \frac{1-\alpha-\beta}{1-(1-\alpha-\beta)(1+r)}(w_{u,t}-h(1+r))$$

The solid black line represents those who choose to stay in the rural region. The dotted black line represents those who choose to migrate while the dotted grey line above it shows the dynamics of bequests from children whose forefathers migrated to the city. Amenity driven migration is not considered in this model, therefore, it is assumed that once families migrate to the city they do not return to the rural region. Therefore, *k*, the steady state of the descendants of rural-urban migrants is calculated by equating $b = (1-\alpha-\beta)[w_{u,t}+(b-h(1+r)]$. If migration ceases, rural families with bequests above g will eventually settle into the stable steady state, *l*, which is the intersection of the solid grey line with the 45-degree axis.

The position of the steady states depend on skilled wages and housing prices, which are in turn determined by the parameters of the model. In the next section we present results from simulations of the equilibrium system under different policy regimes and discuss the fundamentals that drive the various welfare outcomes.

Simulation of the model

Wage and price outcomes are the result of complex interactions between the various parameters of the model. The magnitude and direction of the change in welfare under a particular policy regime will depend on the configuration of these parameters and the initial distribution of wealth. In order to demonstrate that the same policy may have dramatically different welfare implications depending on the characteristics of the region in which they're applied, we simulate the model under different values for δ_u, the knowledge spillovers component in the urban goods production function, and φ, the CES parameter in the housing production function under four policy regimes.[1] For each of these cases, all other parameters are kept constant.

In the first regime no policy is implemented. In the second regime, an education subsidy is granted to all households of the initial generation with bequests less than the fixed cost of education, *h*. Revenues to fund the subsidy program are raised by taxing urban residents so that total taxes equal total subsidies. This would be an example of a person-based policy with direct place-based implications since urban taxpayers fund the program. For the third and fourth regimes, we assume that the same amount of funds

[1] Note that the rural region and the city have the same housing technology.

raised for the subsidy program can instead be invested to increase firm productivity. In the third regime the funds support an increase of 0.01 over the baseline parameter value for δ_r =0.07, the knowledge spillovers parameter in the rural production function, while in the fourth regime they support an increase of 0.02. These are examples of place-based policies that improve the economic vitality of the region without specifically targeting individual households.

The model was simulated in Matlab using Newton-Raphson root-finding routines to solve the nonlinear system of equilibrium equations for each generation. A representative normal distribution of wealth was created for the rural region with a mean lower than the cost of education and a standard deviation twice the mean. The distribution was updated every generation to reflect bequests from parents who chose to stay in the rural region and those who migrated. For the base-line parametrization of the model , we calibrated the system to reflect realistic estimates for various parameters. $\delta_u = 0.1$, $\delta_r = 0.07$, and $\sigma = 0.06$ are within the range of estimated parameter values in the economic geography literature for knowledge spillovers and agglomeration effects (Rosenthal and Strange, 2002; Ciccone and Hall,1996). [2]

Knowledge Spillovers Parameter in City Goods Production, δ_u

The baseline value for δ_u is 0.1. We vary δ_u from 0.09 to 0.125 in increments of 0.001. For the second regime, the root finding routine was unable to satisfactorily converge to a solution for values of δ_u greater than 0.114. We are therefore restricted to a range of 0.09 to 0.114 for the person-based policy regime.

As shown in figure 2a, migration takes place when there are greater positive externalities δ_u in the city. However, the volume of migration varies considerably under the four regimes. As mentioned above, lower-wealth households have more incentives to migrate than medium-wealth households. In regimes 1, 3, and 4, i.e. the regime with no policy, and the two placed-based policy regimes, migration mostly comprises of poorer households with bequest levels below *h* . When these households receive a subsidy, most of them no longer need to migrate to the city to derive higher utility, and so, like their medium-wealth neighbors, choose to stay in the rural region.

Since the volume of migration is lower in the person-based policy regime, rural wages do not vary as much. Conversely, the other three regimes witness a rise in rural wages, as greater rural out-migration leads to higher rural wages for the remaining workers. Housing prices also decrease in these three regimes as aggregate housing demand falls with an outflow of population (Figures 2d and 2e).

[2] Other baseline parameter values are *r*=0.35,*i*=3, $\gamma = 0.75, \varepsilon = 0.15, \alpha = 0.2, \beta = 0.4, \theta = 0.7$. The initial population in the rural region is 350,000 and 500,000 in the city. Land acreage in the urban region is 1,300,000 hectares, and 200,000 hectares in the city. The greater population density in the city causes the agglomeration effects.

Interestingly, housing prices increase under the education subsidy program.This may seem counterintuitive but it illustrates the unapparent and possible unintended consequences of the subsidy. Under the person-based policy regime, when a small number of rural residents migrate, the human capital stock in rural production goes down, which reduces returns to other complementary factors. In particular, a lower marginal product of land implies that less land is desirable in goods production. However, lower returns to land in goods production imply lower opportunity costs of employing land in housing construction. Additionally, under the assumption of full employment of factors and fixed amounts of land in each region, a decline in the utilization of land in one sector means an increase in the other. The upward pressure on housing prices from employing more of the scarce factor in housing production outweighs the downward pressure from the reduction in housing demand as people migrate. To be sure, if the volume of migration were larger, the corresponding reduction in the demand for housing would eventually drive the price down, as in the other three regimes.

What do the different policy regimes imply for long-run welfare outcomes in the rural region? Under the subsidy program, all rural residents are employed as skilled workers. Due to diminishing returns, wages are comparatively lower than those in the other policy regimes. The person-based policy regime therefore reduces income inequality and eliminates the threat of falling into a poverty trap by bolstering participants with additional wealth. However, if the subsidies were unable to cover all poor households in the rural region, households left behind would have fared much better if the program were never implemented. When wages decrease as a result of the heightened competition in the labor force, the minimum level of bequests, g, for escaping the poverty trap increases (Figure 2h). This means that poorer rural households not covered by the program find it more difficult to overcome that threshold and escape poverty. Policy makers must be careful to ensure that the poorest members of society are not left to bear the brunt of these unintended effects.

On the other hand, in regime 3, when the rural human-capital spillover δ_r is increased to 0.08, wages are higher than in the person-based policy regime. However, as shown in figure 2b, for lower values of δ_u, not all rural residents find it profitable to become skilled workers, and their families eventually fall into a poverty trap. In contrast, if the revenues generated from taxing urban residents are able to fund an increase in productivity to δ_r=0.09, all rural residents are able to escape poverty for all values of δ_u. Real rural wages are highest in this policy regime.

Even though regional wage differentials are highest in the second regime, the subsidy program blunts incentives for some participants to migrate. Without the education subsidy, poorer rural residents would have migrated to the city if real urban wages were high enough to compensate for the costs of migration. Figures 2i and 2j show that long-run average welfare for migrants is higher than that for the remaining rural households, suggesting that poorer households would have been better in the long-term if the education subsidy had not discouraged their migration. Rebecca Blank suggests that in situations where economic restructuring has permanently lowered long-term employment opportunities in the region, one may want to instead structure assistance programs to encourage geographic mobility (Blank, 2005).

Constant Elasticity of Substitution Parameter in Housing Production, ϕ

We vary ϕ from -0.7 to -0.2, which correspond to elasticities of substitution in the range of 0.58 and 0.83. When elasticities are higher, capital can be more easily substituted for land. As ϕ increases, the greater substitutability implies that housing prices fall in both regions.

Figure 3a shows that the person-based policy actually facilitates migration for greater elasticities. In the first regime migration occurs only for values of ϕ greater than -0.2 . Migration under the subsidy program starts to take place when ϕ is only -0.3 or when the elasticity of substitution is 0.77. When education is subsidized by taxing urban residents, housing demand falls which reduces city prices, further increasing wage differentials. Therefore, for the same values of ϕ, urban housing is cheaper in the person-based policy regime spurring greater rural-urban migration. Under the-place based policy regimes, higher real rural wages lower regional wage differentials, completely stemming migration for all values of ϕ (Figure 3c). However, when δ_r =0.08, not all rural residents are able to escape a poverty trap. Some households remain unskilled in the long-run as seen in figure 3b.

Figures 3d and 3f illustrate that urban housing prices vary much more dramatically with higher elasticities of substitution than rural housing prices. Because land is more scarce in the city, housing prices are more sensitive to changes in the elasticity of substitution between capital and land, whereas in the rural region the abundance of land implies that greater flexibility in using land has a smaller impact.

Even though more migration is induced under the subsidy program than under the other regimes, it is still not enough to prevent a modest increase in housing prices. As discussed above, if upward pressure on housing prices by using more land is not exceeded by an aggregate reduction in housing demand, housing prices will still increase slightly as migration occurs. Migration on the order of 10% of the rural population, which also happens to comprise of some of the poorest residents of the region, is not enough to considerably alter housing demand.

In terms of long-run welfare outcomes, poorer families under the subsidy program fare quite well for higher values of ϕ. Households who initially migrated in the first generation eventually settle into a high welfare steady state. Without the subsidies, these households would not have been able to migrate and would have had to settle for lower long-run welfare, with some of the poorest falling into a poverty trap. Even in contrast to the place-based regimes where all residents remain due to relatively higher real rural wages, poorer households who are able to migrate when education is subsidized do much better (Figures 3i and 3j). However, wealthier rural residents in the person-based policy regime would have to settle for lower real wages due to the enhanced competition from the larger skilled labor pool.

Conclusion

This paper extends the literature on poverty traps and regional economics by incorporating rural-urban migration, human capital externalities, and regional agglomeration effects into Galor and Zeira's (1993) overlapping generations model to examine the welfare impacts of various rural poverty alleviating strategies. We simulate the model to demonstrate how regions with different production and housing technologies may respond differently to a given policy. In particular, we were interested in the effects of various person-based versus place-based policies and their effects on welfare and on whether they induce a rural brain drain.

Our results show that for certain cases, well intended policies targeting poor households may instead worsen their long-run welfare outcomes if households prefer not to migrate to the wealthier urban region when awarded a subsidy. Indeed, person-based policies reduce income inequality, but may precipitate poorer families towards a poverty trap if program costs are too high to cover all of them. Place-based policies that do not target individuals , but instead, improve the productivity of rural firms, have the potential to increase average rural welfare. However, the benefits of such policies may not trickle down to the least disadvantaged. In other cases, person-based policies are shown to improve the long-run welfare of poorer households by facilitating migration to the city. Place-based policies actually hinder migration, but if productivity hikes are substantial they may reduce the likelihood of falling into a poverty trap while increasing real rural wages. Our model provides a formal framework that addresses the fundamentals that may drive these contrasting welfare responses and in better understanding when place or people-based policies are relatively more appropriate.

References

Baumann, R.W., and Reagan, P. B. (2005), "The Appalachian Brain Drain", working paper.

Becker, G.S., and Tomes, N. (1979), "An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility", *Journal of Political Economy*, 87-6, 1153-1189.

Blank, R. (2005), "Poverty, Policy, and Place: Local Characteristics," International Regional Science Review, 28-4, 441-464.

Carter, M.R., and Barrett, C. B. (2006), "The Economics of Poverty Traps and Persistent Poverty: An Asset Based Approach" *Journal of Development Studies*, 42-2, 178–199.

Charles, K.K., and Hurst, E. (2003), "The Correlation of Wealth Across Generations", *Journal of Political Economy*, 111-6, 1155-1182.

Ciccone ,A.,and Hall, R.E. (1996), "Productivity and the Density of Economic Activity," *American Economic Review*, 86-1,54-70.

Easterly, W. (2001), *The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics*. The MIT Press, Cambridge, MA.

Fujita, M., and Thisse, J. eds. (2002), *Economics of Agglomeration: Cities, Industrial Location and Regional Growth*, Cambridge University Press, Cambridge, UK.

Galor, O., and Zeira, J. (1993), "Income Distribution and Macroeconomics", *Review of Economic Studies*, 60, 35–52.

Helpman, E. (1998),"The Size of Regions", *Topics in Public Economics*, Pines, Sadka and Zilcna eds., Cambridge University Press, 33-54.

Henderson, J.V., and Wang, H.G. (2005), "Aspects of Rural-Urban Transformation of Countries," *Journal of Economic Geography*, 5, 23-42.

Kraybill, D., and Kilkenny, M. (2003), "Economic Rationales For and Against Place-Based Policies," for the Organized Symposium, "*Rural Development , Place-based Policy: Sociologists Critique Economists,"* AAEA-RSS Annual Meeting, "Spatial Inequality: Continuity and Change in Territorial Stratification," Montreal, Canada.

Mazumder, B. (2005), "Fortunate Sons: New Estimates of Intergenerational Mobility in the United States Using Social Security Earnings Data", *Review of Economics and Statistics*, 87-2, 235-255.

Partridge, M.D., and Rickman, D.S. (2006), *The Geography of American Poverty: Is there a Need for Place-Based Policies?* W.E. Upjohn Institute for Employment Research, Kalamazoo, MI.

Partridge, M.D., and Rickman, D.S. (2008), "Distance from Urban Agglomeration Economics and Rural Poverty," *Journal of Regional Science*, 48-2, 285-310.

Rosenthal, S.S., and Strange ,W.C. (2002), "Evidence on the Nature and Sources of Agglomeration Economies," *Handbook of Urban and Regional Economics*, Mills, E.S. ed., Elsevier Science Pub. Co., New York, N.Y.

Solon, G. (1992), "Intergenerational Income Mobility in the United States," American Economic Review, 82-3, 393-408

Regional responses to various policy regimes under different values of δ_u

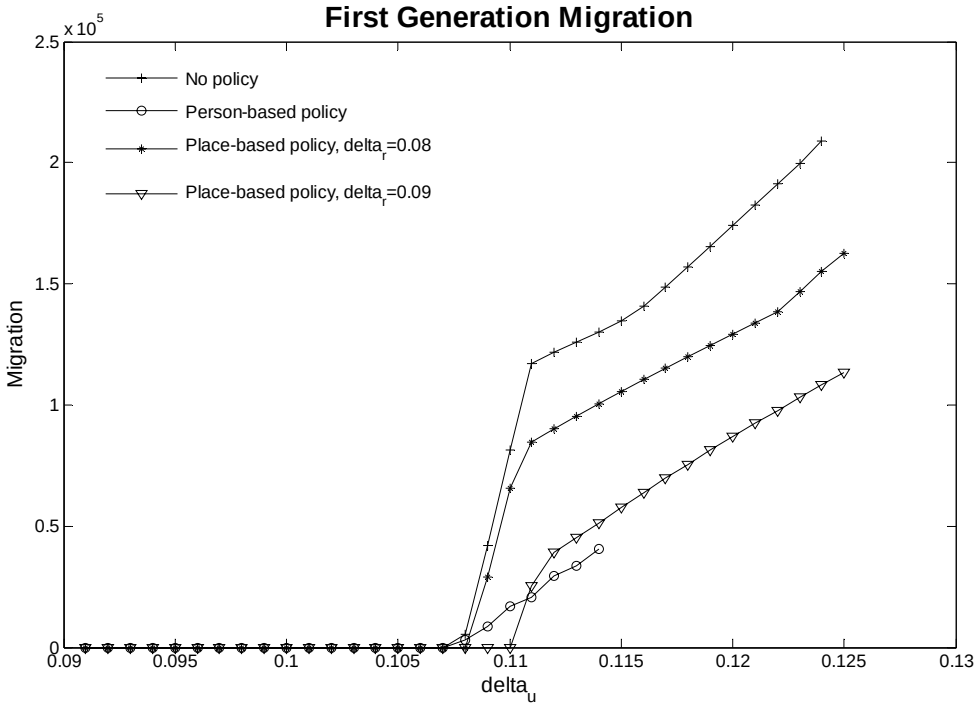


Figure 2a

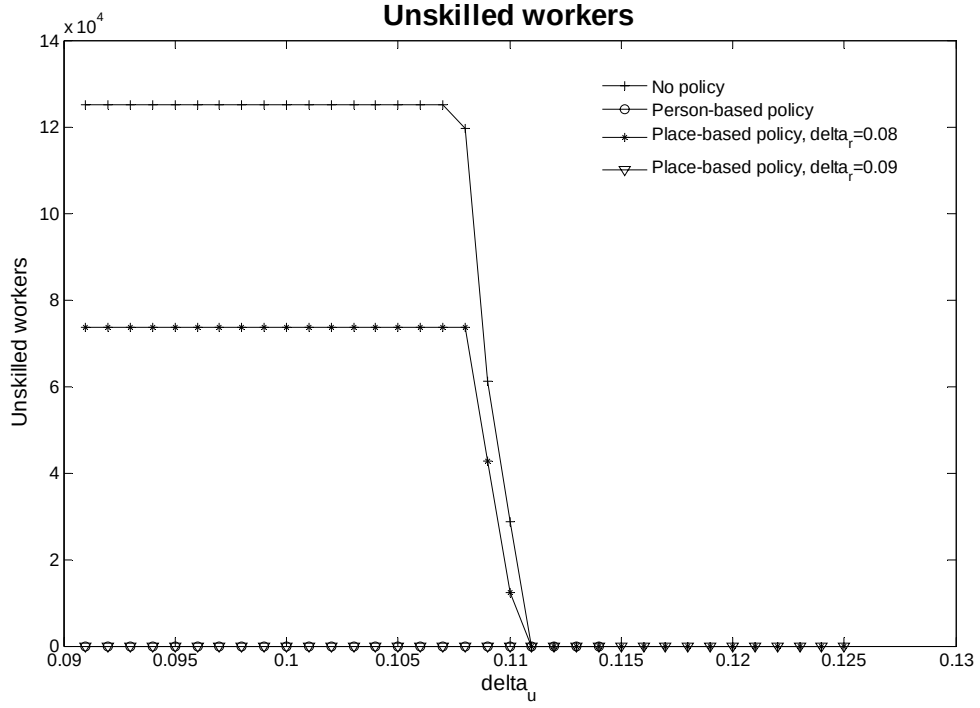
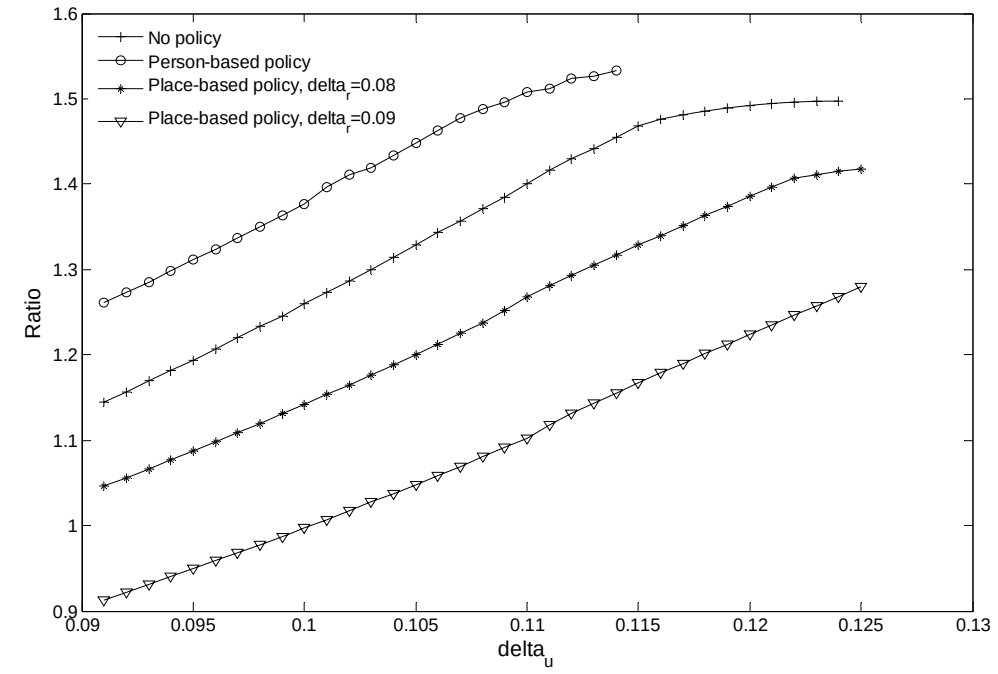


Figure 2b



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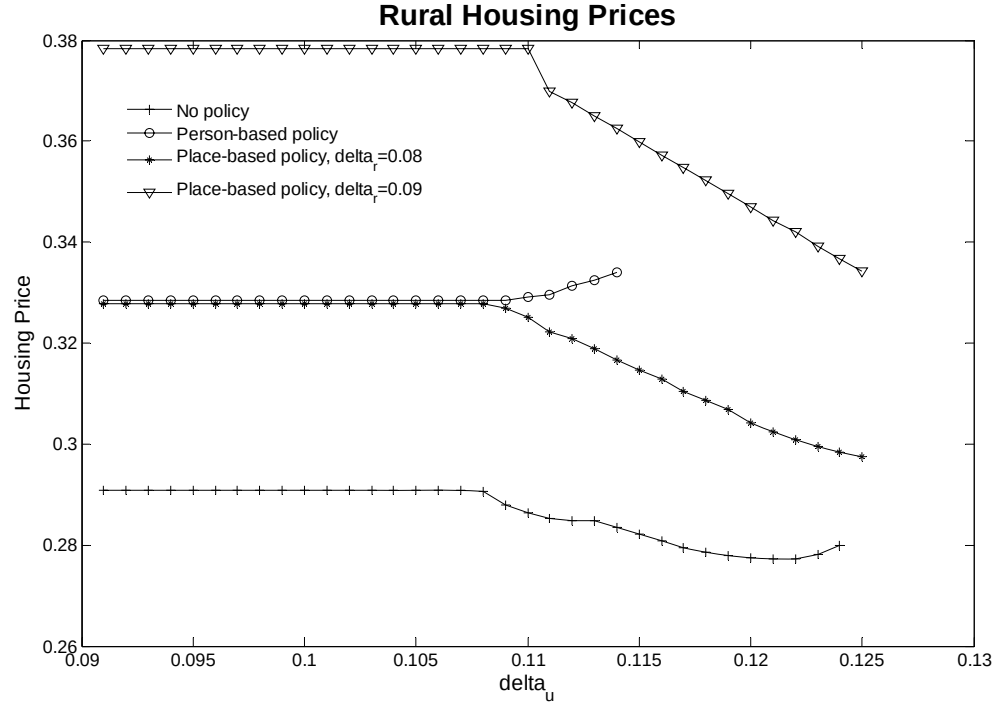

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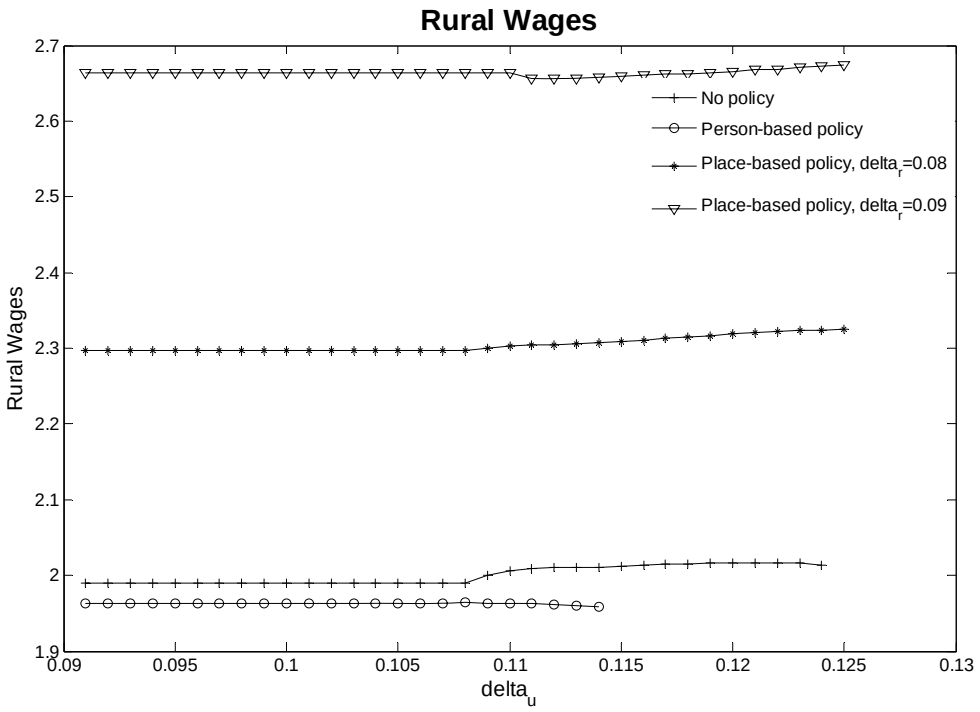

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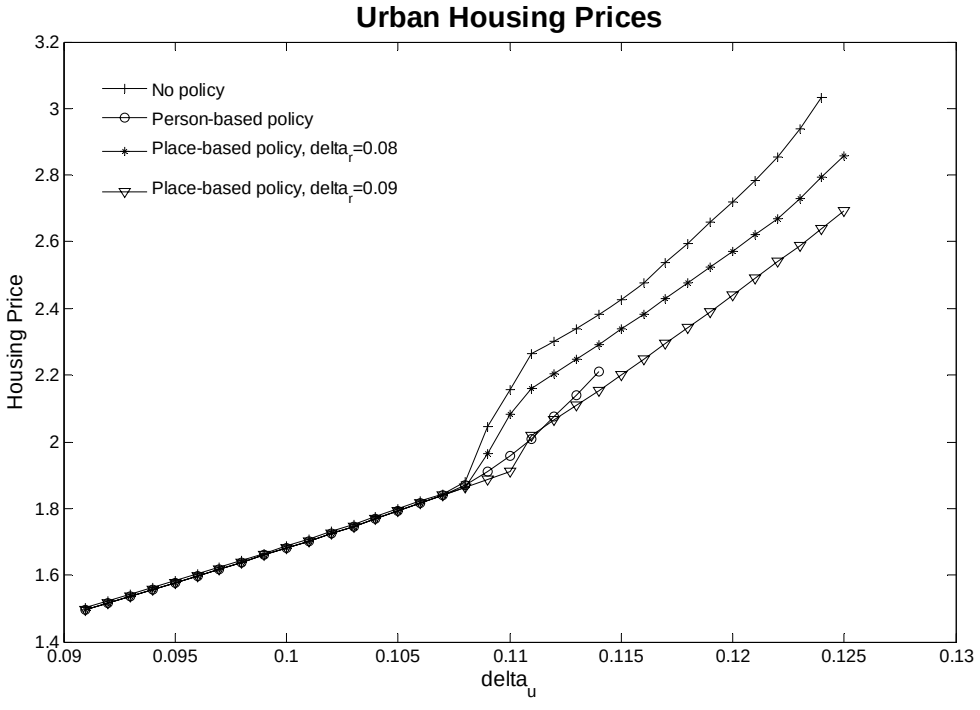

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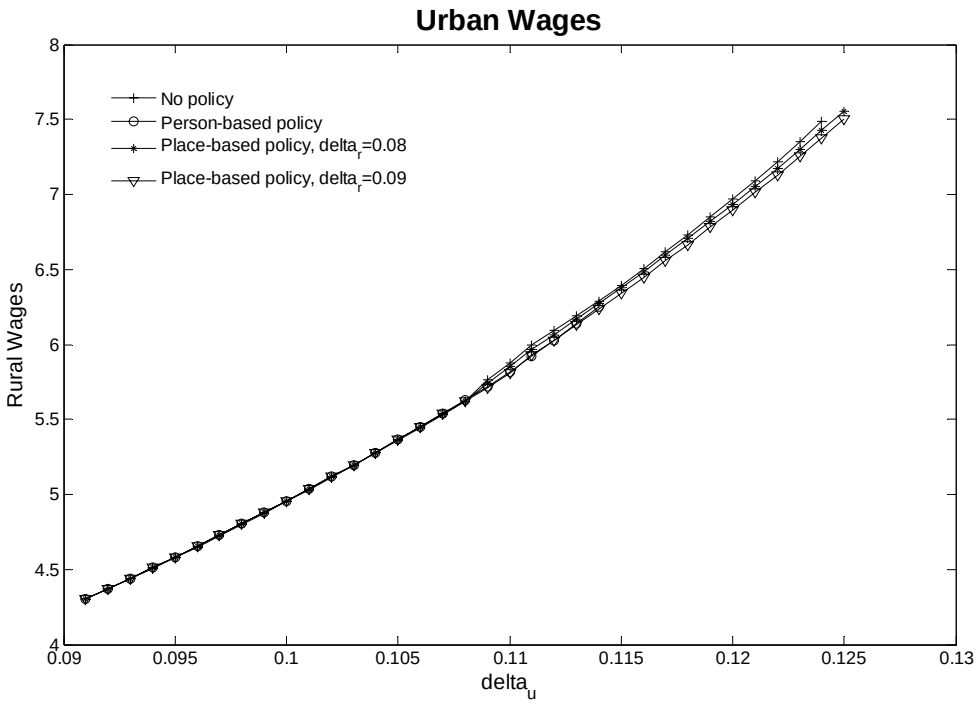


Figure 2g

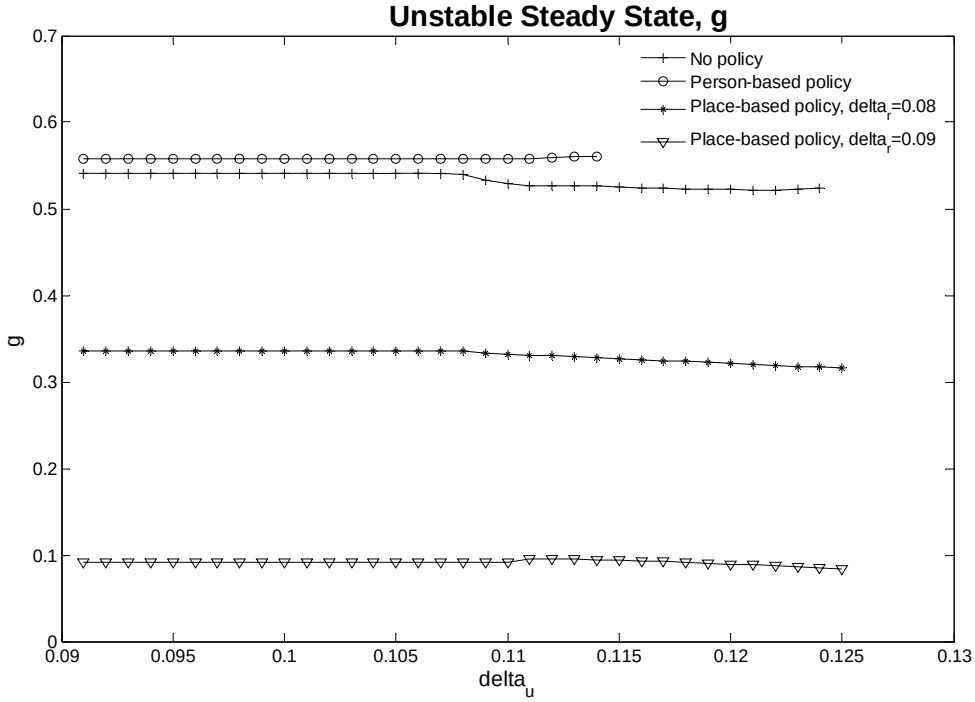


Figure 2h

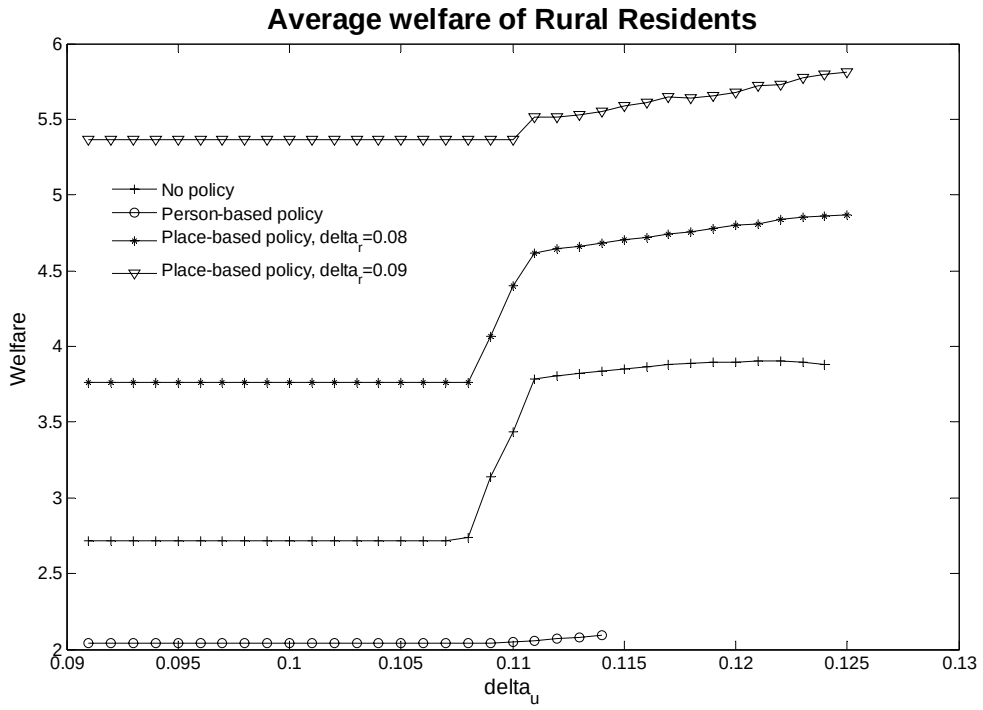


Figure 2i

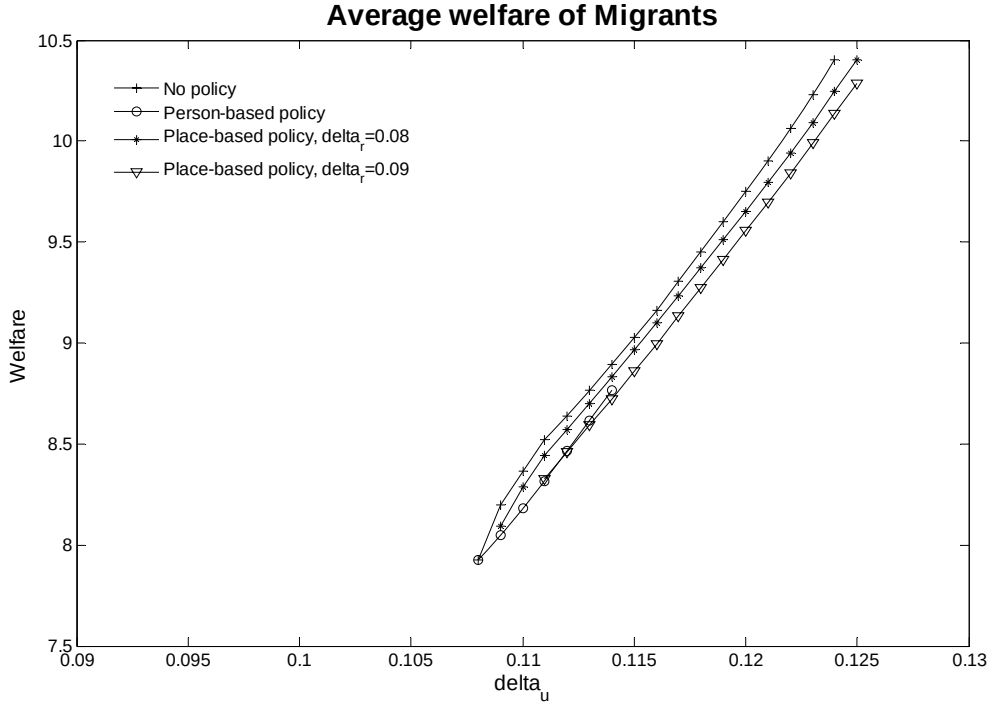


Figure 2j

Regional responses to various policy regimes under different values of ϕ

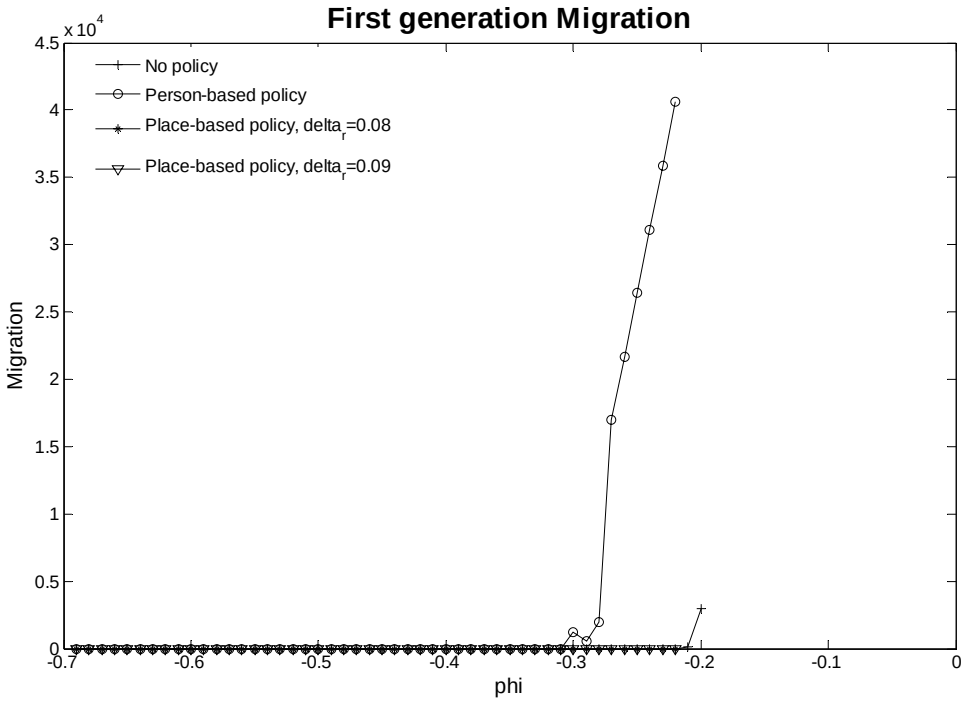
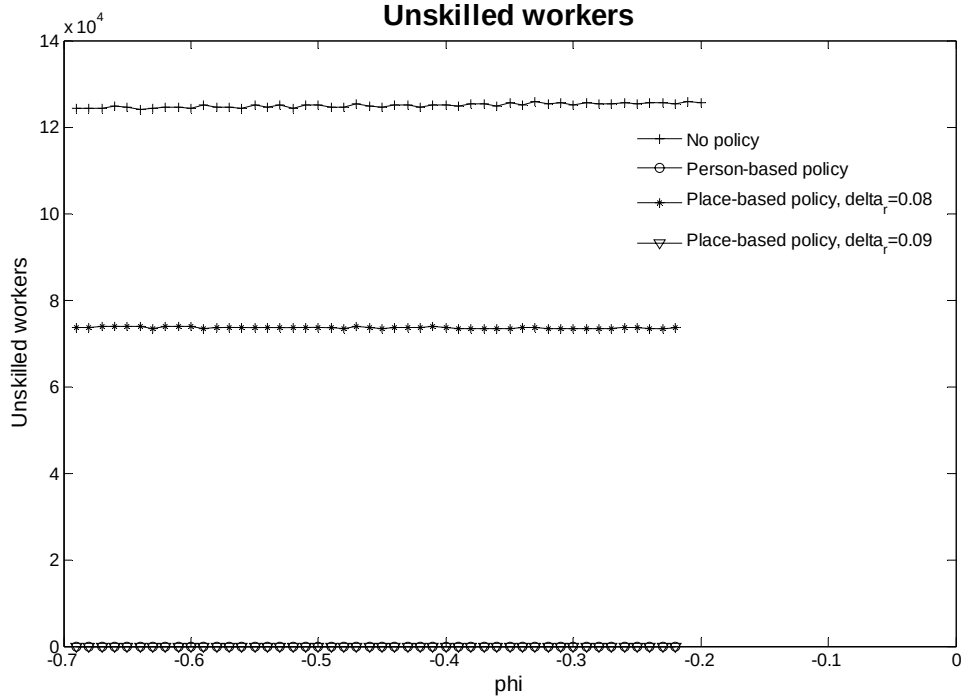


Figure 3a



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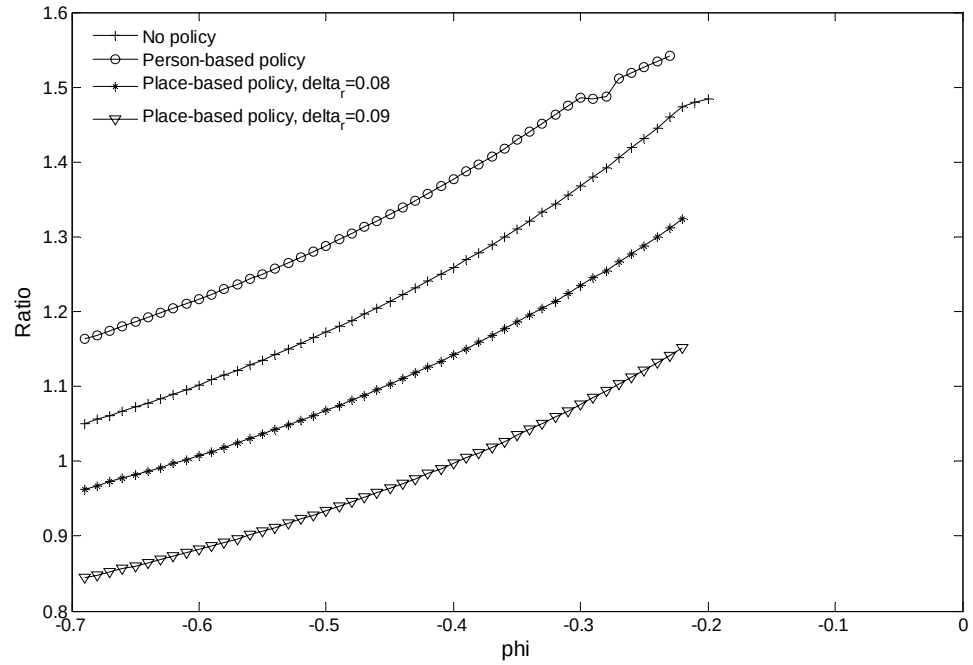

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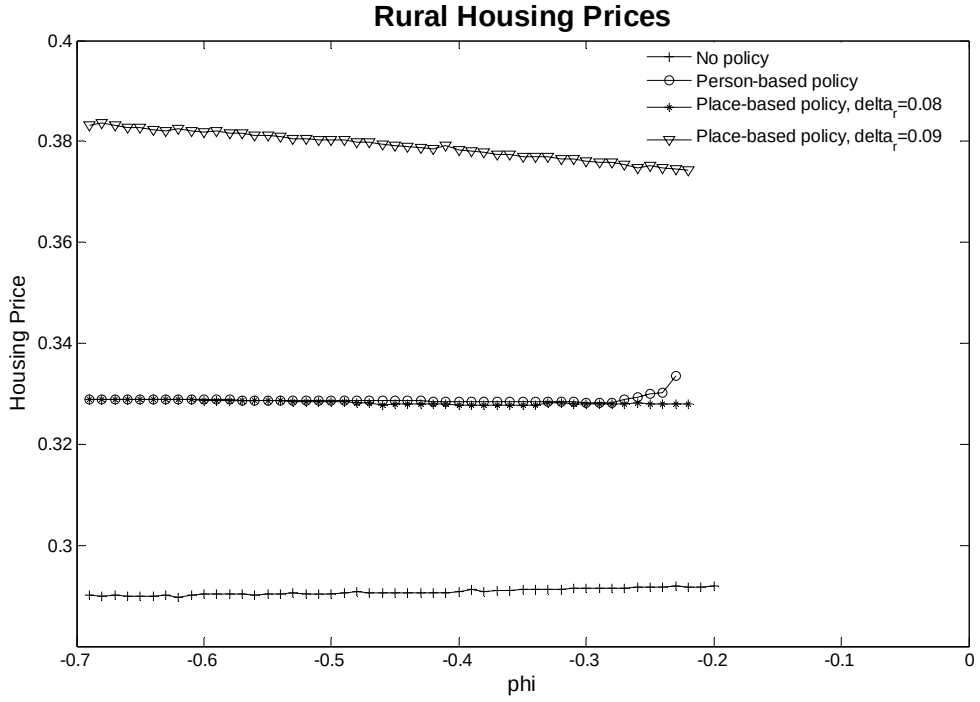

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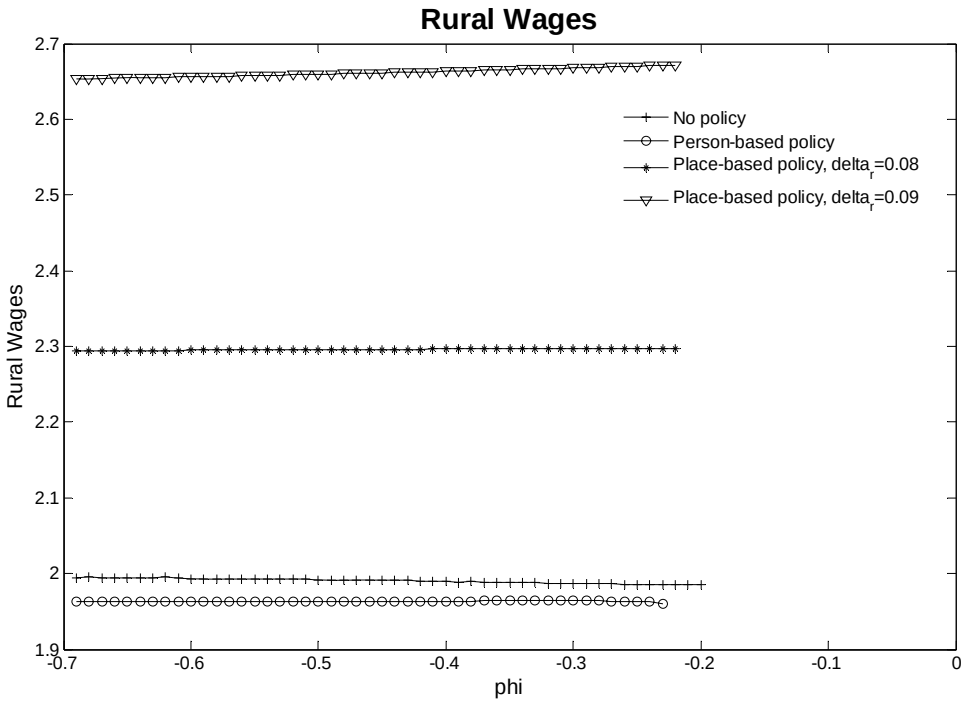

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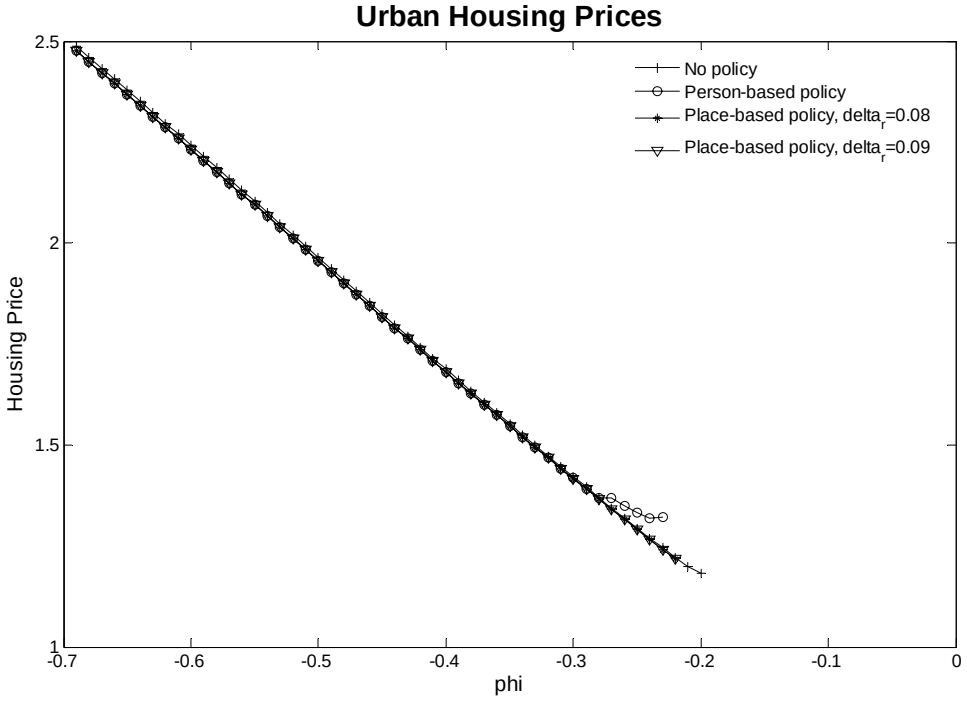

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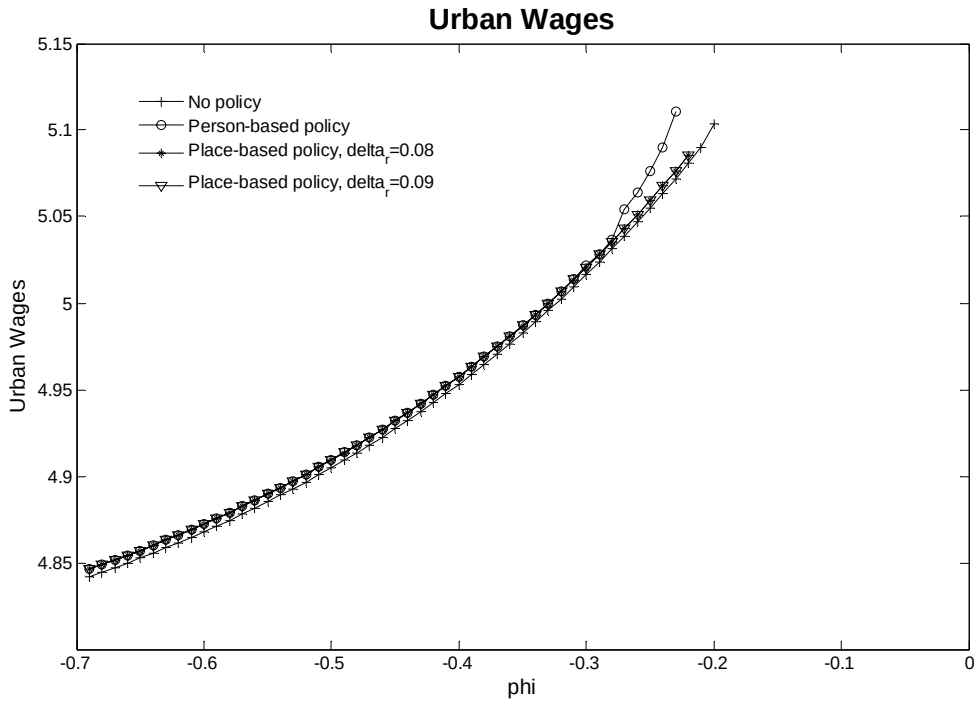

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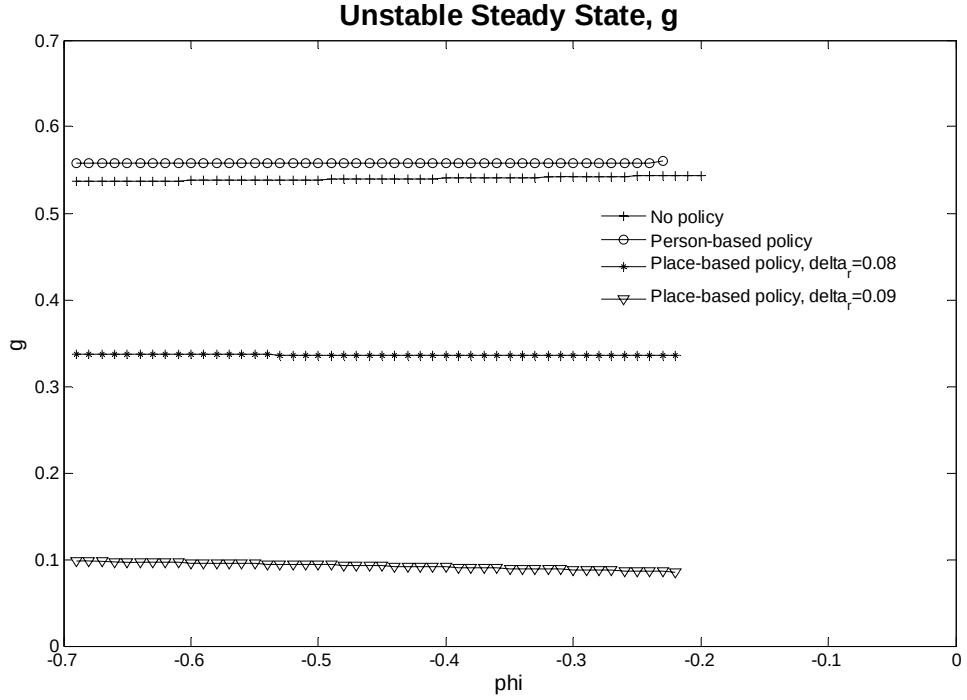

Figure 3h

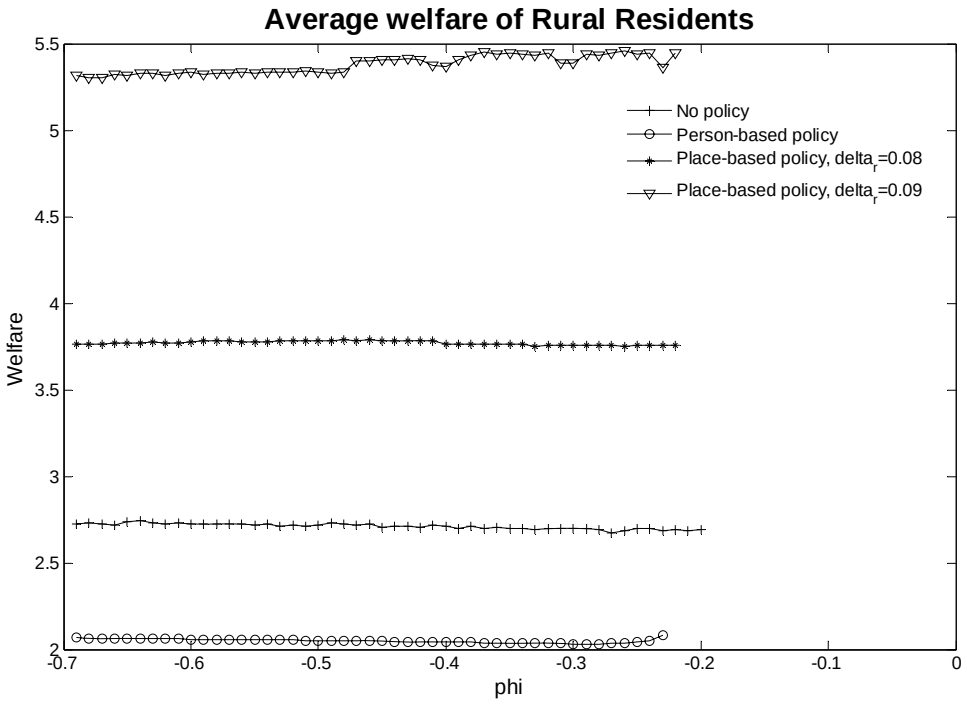

Figure 3i

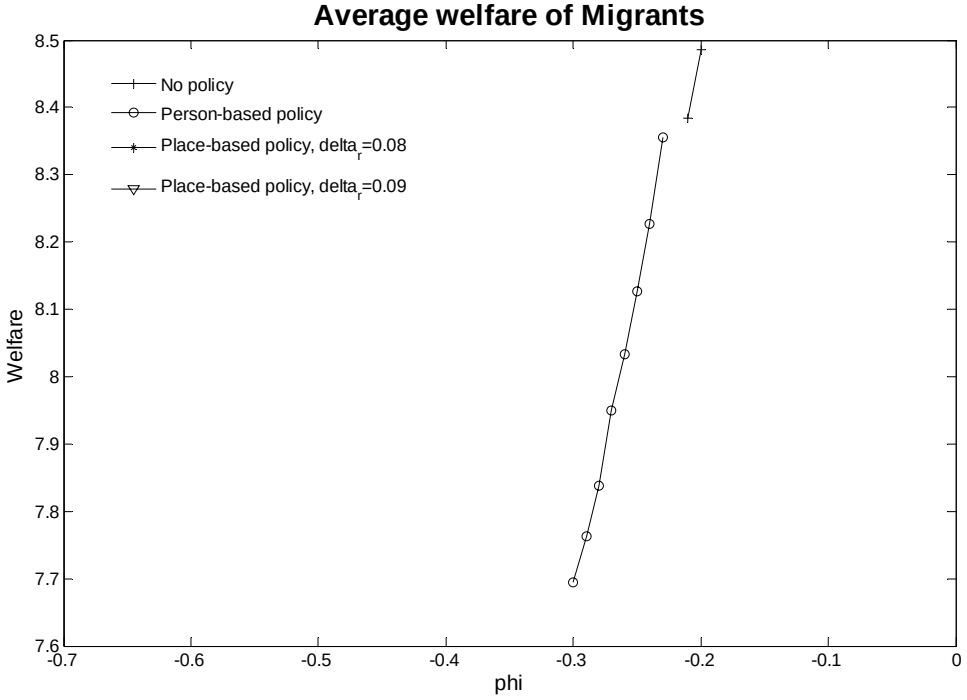

Figure 3j