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A Dynamic Brain Drain in Peripheral Regions

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A Dynamic Brain Drain in Peripheral Regions

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Abstract

The aim of this research is to explore the effect of a lower return on education in peripheral regions of a country compared to core regions on the decision of individuals in each region to acquire human capital by advancing their education. In addition, the study examines how these decisions may endogenously increase the income gap between the core region and the peripheral region. We first build a theoretical model that explains the individual's decisions regarding the acquisition of human capital using different production functions in each region. Thereafter, we conduct a simulation, using data from Israel's Central Bureau of Statistics, to evaluate the main parameters of the model.

Key Words

Human Capital, Periphery, Employment

Introduction

The tendency for spatial concentration has been analyzed and investigated by many scholars, generally under the title of the "core-periphery" issue, and more recently under the theme of the "new economic geography" (Krugman 1991). Another important dimension of this model is the social optimum versus the free market location of the economic activity (see Malul and Bar-El 2009).

Differences in the amount of economic activity and the quality of various amenities such as infrastructure between the core and the peripheral regions may lead to differences in the productivity of workers in each region (see, for example, Ciccone and Hall 1996, Davis and Weinstein 1999, Hanson 1998, Segal 1976). Greater productivity may lead to higher wages in the core region than in the peripheral region (Ciccone and Hall 1996, Krugman 1991). The wage gap is expected to be larger for skilled workers (Black 1999), implying that the return on education is expected to be greater in the core region (Ciccone and Peri 2000, Moeller 2002). In turn, the greater return on education in the core region may increase the incentive of workers in this region to advance their education (Stratton and Wetzel 2008). Glaeser and Mare (2001) found that the accumulation of skills among those who live in cities is greater than among those who live outside metropolitan areas.

In this paper we will focus on the impact of regional attributes on the individual's decision to acquire higher education. Our hypothesis is that, after controlling for individual characteristics, the lower wages in the periphery makes the return on education less worthwhile in this region, thereby dampening the incentive for individuals in the periphery to acquire higher education. This situation may lead to an increase in the wage gap between the regions, exacerbating the disparity in educational levels between them as well. The innovative approach of this study is that it deals with the dynamic negative impact of the differences in the regions that are attributed to the labor

force's decisions about acquiring human capital and the dynamically increasing inequality between the core and peripheral regions.

In the next section we present the theoretical model. Then we conduct a simulation of the model using the case of Israel. We end the paper with a discussion of the policy implications and our conclusions.

The Model

The model is based on the framework developed by Agell and Lummerud (1997) and Malul and Luski (2009). Assume two economic regions in a country, one the core region and the other the periphery. Initially, the labor force in each region is fixed. Individuals have varying abilities, and we assume that the distribution of abilities is identical in the two regions.

Every individual has to decide whether to be employed or remain outside the work force, his/her desired professional level, and how much to invest in learning and training. These decisions are not independent of each other, and the individual's optimal decision is affected by his/her personal traits as well as the situation in the labor market.

The Labor Market Model: Assumptions and Notations

The professional level of an individual (e_i) is determined by his/her investment in learning and training. Individuals can improve this level by investing time and money in training and learning. The value of a worker's output (y_i) is a function of his/her professional level. For simplicity, we assume that $y_i = \delta_j * e_i$ where $\delta_j > 0$ (j is an index for the region: j=C for the core region and j=P for the peripheral region). δ_j is increasing with the scope of economic activity in the region (Ciccone and Hall 1996, Krugman 1991). ($\frac{\partial \delta}{\partial K} > 0$) where K is, for example, the accumulated physical capital in a region. We assume that at the starting point the scope of

economic activity (K_c) in the core region is higher than that in the peripheral region (K_p). Therefore, $\delta_c > \delta_p$. Furthermore, w_i denotes the worker's wages. It is assumed that the labor market is competitive and that the worker receives a wage that is equal to his/her productivity:
 $w_i = y_i$.

The assumptions and notations regarding training and learning are as follows: Every individual has different characteristics μ_i that determine his/her ability to learn and to be trained. Individuals can change their professional level e_i by investing in training and learning $\frac{1}{\alpha\mu_i} e_i^\alpha$ where $\alpha > 1$, simply say, increasing marginal cost of acquiring education.

B denotes the utility of unemployed individuals. It includes the value of home production or leisure and income from other sources (such as unemployment benefits, etc.). The variables w_i, B, y_i are the current value of income from wages, the utility of the unemployed, and output.

Individuals' decisions about working and training

Following Agell and Lummerud (1997), it is assumed that in order to maximize utility the individual first determines the level of training that maximizes his/her returns from work and then compares it to the alternative option of not working. Each individual determines his/her professional level e_i by investing in training. The cost of training to achieve a professional level of e_i is $\frac{1}{\alpha\mu_i} e_i^\alpha$, where μ_i is the individual's ability to learn and train. Thus, the individual strives to maximize the following utility function:

$$\max_{e_i, L} U = L(w_i - \frac{1}{\alpha\mu_i} e_i^\alpha) + (1 - L)B$$

The value of the utility of an individual who works (L=1) is: $\delta_j^{\frac{\alpha}{\alpha-1}} \left(\frac{\alpha-1}{\alpha} \right) \mu_i^{\frac{1}{\alpha-1}}$, while one

who remains out of work (L=0) receives a utility level of B. Therefore, an individual works if

his/her parameter of ability satisfies $\mu_i \geq \frac{\left[\left(\frac{\alpha}{\alpha-1} \right) B \right]^{\alpha-1}}{\delta_j^\alpha}$. An individual whose ability satisfies

$\mu_i < \frac{\left[\left(\frac{\alpha}{\alpha-1} \right) B \right]^{\alpha-1}}{\delta_j^\alpha}$ does not work and chooses the lowest possible professional level ($e_i = 0$).

Proposition 1: Individuals from the periphery will choose a lower professional level compared to individuals with similar abilities from the core region.

The level of professional level that the population in the peripheral region will acquire is $e_i = \delta_j^{\frac{1}{\alpha-1}} \mu_i^{\frac{1}{\alpha-1}}$, which is dependent upon δ . In turn, this variable is a function of the initial scope

of economic activity in each region. Such a relationship implies that individuals from the core region where the initial scope of economic activity is higher will choose to acquire a higher level

of professional level for a given ability (i.e. $\frac{\partial e_i}{\partial \delta} = \left(\frac{1}{\alpha-1} \right) \delta^{\frac{2-\alpha}{\alpha-1}} \mu_i^{\frac{1}{\alpha-1}} > 0$). Q.E.D.

The wages of an individual from the core region with an ability level of μ_i will be higher than

those of a person with the same abilities from the periphery $w_i = \delta_j^{\frac{\alpha}{\alpha-1}} \mu_i^{\frac{1}{\alpha-1}}$ (i.e.

$\frac{\partial w_i}{\partial \delta} = \left(\frac{\alpha}{\alpha-1} \right) \delta^{\frac{1}{\alpha-1}} \mu_i^{\frac{1}{\alpha-1}} > 0$). Thus, the gap in wages between the regions will be larger than the

gap in professional level because $w_i = \delta_j e_i$.

<Figure 1 about here>

Figure 1 illustrates the gap in wages for an individual with a certain ability μ^0 . Thus, the total wage gap is A+B. This gap includes two components. A represents the gap that stems from the fact that for a given professional level, the productivity in the core region is higher at the rate of δ . Therefore, wages are higher in the core region. B represents the gap that stems from the decision in the periphery to acquire a lower level of professional skills. Actually, B represents the additional gap between the wages that is determined endogenously in our model.

Proposition 2: The level of unemployment will be higher in the peripheral region than in the core region.

The level of unemployment in the peripheral region will be higher than that in the core region.

The additional number of unemployed workers will be: $\Delta UN = \left(B \left(\frac{\alpha}{\alpha-1} \right) \right)^{\alpha-1} \left[\frac{1}{\delta_p^\alpha} - \frac{1}{\delta_c^\alpha} \right]$. The

initial gap in the scope of economic activity (K) leads to a larger gap in unemployment when comparing the core region with the periphery. Q.E.D.

Figure 2 illustrates the employment gap between the core and the peripheral regions. The figure demonstrates that all individuals with abilities between $\frac{2B}{\delta_c^2}$ and $\frac{2B}{\delta_p^2}$ will be employed in the core region. However, those in the peripheral region with the same range of ability levels will remain unemployed.

<Figure 2 about here>

The spillover effect of knowledge

An individual's decision to advance his/her education may increase his/her productivity. However, it may also generate other positive effects through knowledge spillover that may increase the productivity of other individuals in the geographic area. For example, as Lucas (1988) notes, the sharing of knowledge and skills through formal and informal interactions may benefit other workers. Rauch (1993) demonstrates that while one's wages are contingent upon one's educational achievements, they are also positively related to the average educational level in the metropolitan area in which he/she lives. Conley et al. (2003) found that the external benefits are greater for individuals who are located close to one another.

Assume that $\delta = F(K, HC)$, where K is the accumulated physical capital in the region and HC is the accumulated human capital in the region. Assume that $\frac{\partial \delta}{\partial K} > 0$ and $\frac{\partial \delta}{\partial (HC)} > 0$. In other words, as the average level of human capital in the region increases, the productivity of each worker in the region increases as well. We retain our previous assumption that the scope of economic activity in the core region is higher than the scope in the peripheral region. Assume now that a certain individual acquires an advanced education and that the individual with the highest ability in each region makes this decision first. As we showed in the previous section, for a given ability, the level of professional level will be higher in the core region: $\delta_C^{\frac{1}{\alpha-1}} \mu_i^{\frac{1}{\alpha-1}} > \delta_P^{\frac{1}{\alpha-1}} \mu_i^{\frac{1}{\alpha-1}}$. This will increase the gap in δ between the regions. Therefore, for the next individual the gap in δ between the regions will be larger than the initial gap. Ultimately, this process will culminate in a larger gap in wages and unemployment rates between the regions than had been the case in the basic model. In addition, the benefits that those in the core region obtain from the spillover of knowledge increase the gaps in the level of education and wages between the two regions.

Moving between the regions

Now let us assume that moving between the regions is allowed and that the cost of moving from one region to the other is τ (present value) (assume that $\tau > 0$). Individuals will decide to move from one region to the other if the gap between his/her expected utility in the core region compared to the periphery is greater than the cost of moving.

Proposition 3: The option to move between the regions will encourage those in the periphery with relatively high abilities to move to the core region.

Let us consider both cases:

1. An individual who chooses to work in the periphery will decide to move to the core region if his/her expected utility in the core region is higher than the current expected utility in the periphery (after deducting the costs of moving). All individuals with abilities

that satisfy $\mu_i > \frac{\left(\tau \left(\frac{\alpha}{\alpha-1}\right)\right)^{\alpha-1}}{\delta_c^\alpha - \delta_p^\alpha}$ will move from the peripheral regional to the core region

due to the greater utility they could expect to obtain there. As the cost of moving drops or the gap in the level of economic activity between the core and peripheral regions increases, more individuals will decide to move.

2. An unemployed individual who lives in the periphery will stay out of work and have an expected utility of B. However, if that individual moves to the core region, he/she may improve his/her utility by working. In that case all of the individuals with abilities that

satisfy $\mu_i > \frac{\left((B + \tau) \left(\frac{\alpha}{\alpha-1}\right)\right)^{\alpha-1}}{\delta_c^\alpha}$ will move from the peripheral regional to the core

region and enjoy an expected utility equal to $\delta_c^{\frac{\alpha}{\alpha-1}} \left(\frac{\alpha-1}{\alpha} \right) \mu_i^{\frac{1}{\alpha-1}} - \tau$. This rate is higher than the expected utility (B) these individuals would obtain by remaining in the periphery.

The results from cases 1 and 2 imply that it will be worthwhile for individuals with abilities above a certain level to move from the periphery to the core region. The threshold of abilities that determine whether an individual would benefit from such a move depend upon the gap in the level of economic activity between the regions and upon the cost of moving. It is possible that an individual who would otherwise decide to work in the periphery may decide to move to the core region. Such an event will occur only if the gap in the expected utility is greater than the cost of moving. It is also possible that an individual who decides to stay unemployed if he/she remains in the periphery may change his/her mind and decide to move to the core region and find work. Such an event will occur only when both the cost of moving is relatively low and the gap in infrastructure between the regions is relatively high. Such movements will leave only those with low-level skills in the periphery, increasing the wage gap between the regions and leading to a brain drain from the periphery. Q.E.D

We should note that large-scale migration to the core region might increase the prices in that region, thereby reducing the real wage gap between the regions and make moving less beneficial. However, this effect may only dampen the migration effect, not reverse it. In that case only individuals with very high abilities from the periphery will still move to the core regions.

3. Simulations

In order to illustrate the model, we conducted a simulation using a method similar to that used in Malul (2009). The simulation is based on the Israel Bureau of Statistics' (Central Bureau of Statistics) income survey (2004), which includes 20,109 subjects--15,295 from the core region in Israel (the area in the center of the country and around Tel Aviv) and 4,814 from the periphery

(areas in the southern part of the country). The simulation was conducted by applying the results from the previous section to the data set.

For simplification, let us assume that $\alpha = 2$. In such a case, individuals will decide to work if their ability μ_i satisfies this condition: $\mu_i > \frac{2B}{\delta^2}$. The level of professional level that each individual acquires will be $e_i = \delta\mu_i$ and the wages earned will be $w_i = \delta^2\mu_i$.

We ran the model for various values of δ ranging from 1 to 1.25 (assuming that the δ in the periphery was always normalized to 1). The model was first calibrated to the current state (see $\delta = 1.1$ in Table 1). It was assumed that the individuals' abilities (μ_i) were uniformly distributed in the range $[0,1]$ and that the distribution of abilities was similar in the two regions.

As can be seen in Table 1 and Figure 3, the value of δ is critical in determining the education gap as well as the wage and unemployment gap between the core region and the periphery. As the gap in δ increases, the gap in employment, education and wages increases as well. In addition, we can see that as the δ increases, the GDP in the periphery, compared to its potential GDP, decreases. For example, if the δ in the current state ($\delta = 1.1$) is the same in the periphery, the GDP in this region will increase by 26.2%.

<Table 1 about here>

<Figure 3 about here>

Policy implications

It would appear that the outcome of the free market is not efficient in that the human capital in the peripheral region is not fully used. We draw this conclusion from several findings:

1. Individuals who choose to work in this region choose to do so at relatively low levels of professional attainment compared to identical individuals in the core region.
2. Some individuals will voluntarily remain unemployed due to the poor wages in this region.

3. There is a large income gap between the regions.

One solution to this problem is having the government fix this market failure by subsidizing professional training in the peripheral region. The role of the subsidy would be to compensate individuals from the periphery for the lack of physical capital in that region. For those with the appropriate ability level, such a subsidy would create an incentive to acquire a higher level of professionalism, reducing the waste created by the gap in the initial level of economic activity between the regions. For example, if the subsidy rate for education were equal to s , the level of professional level that each individual would choose to acquire would be:

$$e_i = \left(\frac{\delta_j}{(1-s)} \right)^{\frac{1}{\alpha-1}} \mu_i^{\frac{1}{\alpha-1}} > \delta_j^{\frac{1}{\alpha-1}} \mu_i^{\frac{1}{\alpha-1}}. \text{ Indeed, Shindo (2010) found that government subsidies in}$$

education foster the economic growth of regions by increasing the return on education in poorer areas. Encouraging people to accumulate more human capital might also generate positive feedback such as increasing the marginal productivity of physical capital in the periphery (Lucas 1988). An increase in physical capital would, in turn, reduce the gap in productivity between the regions and allow a more efficient use of the labor force in the periphery.

Conclusions

In this paper we analyzed the impact of differences in the initial scope of economic activity in the core region and the periphery on the accumulation of human capital in each region and the resulting gaps in income. We first built a theoretical model, which shows that the initial difference in the scope of economic activity may dampen the desire of individuals living in a peripheral region to seek a higher level of education. The decision not to pursue advanced training leads, in turn, to lower wages and higher unemployment in that region. In addition, those with

ability will choose to leave the periphery, creating a brain drain that will further impoverish the periphery.

In order to illustrate the results from the theoretical part, we conducted a simulation using Israeli data. We found that an initial gap of 10% in the scope of economic activity in the region between the core and the peripheral region might lead to a 10% gap in the professional level of two individuals with identical abilities, one from the core region and the one from the periphery. The gap in their wages will be 21%. Such inequalities may lead to a loss of about 26% in the GDP of the peripheral region and to about 9% higher unemployment in the peripheral region than in the core region. The results in our paper actually imply that the outcome of the free market is not efficient in that the human capital in the peripheral region is not fully used. One suggestion for ameliorating this situation is for the government to subsidize professional training in the peripheral region. The role of the subsidy is to compensate individuals from the periphery for the lower initial scope of economic activity in that region. For those with the appropriate ability level, such a subsidy would create an incentive to acquire the same level of professionalism as that acquired by comparable individuals in the core region. Acquiring such a level of professionalism will prevent the waste of human capital in the peripheral region and improve the region's GDP.

Bibliography

Agell, J. and Lommerud, K. E., (1997), Minimum Wages and the Incentives for Skill Formation, *Journal of Public Economics*, 64:25–40.

Bar-El, R. and Felsenstein, D., (1990), Entrepreneurship and Rural Industrialization: Comparing Urban and Rural Patterns of Locational Choice in Israel, *World Development*, 18(2):257-67.

- Black, D., (1999), Local Knowledge Spillovers and Inequality, ERSA conference papers ersa99pa409, *European Regional Science Association*.
- Ciccone, A. and Hall, R., (1996), Productivity and The Density of Economic Activity, *The American Economic Review*, 86:54-70.
- Ciccone, A. and Peri, G., (2000), Human Capital and Externalities in Cities (October 2000). Univ. Pompeu Fabra, Economics Working Paper No. 494.
- Coelen P.S., Nakosteen, A.R. and Zimmer, A.M., (1987), An Aggregate Model of Manufacturing Firm Migration, *Review of Regional Studies* 17(2):57-66.
- Conley, T.G., Fredrick, F. and Tsiang, G. (2003), Spillovers from Local Market Human Capital and the Spatial Distribution of Productivity in Malaysia, *Advances in Economic Analysis & Policy*, Vol. 3 No. 1 Article 5.
- Davis, R. and Weinstein, D., (1999), Economic Geography and Regional Production Structure: an Empirical Investigation, *European Economic Review*, 43:379-07.
- Glaeser, E. L. and Mare, D. C. "Cities And Skills," *Journal of Labor Economics*, 2001, v19(2, Apr), 316-342.
- Hanson, H.G., (1998), Market Potential, Increasing Returns and Geographic Concentration, *National Bureau of Economic Research*, Working Paper :6429.
- Hodgkinson, A., Nyland, C. and Pomfert, S., (2001), The Determination of Location in New South Wales, *Regional Studies* 35.1:39-55.
- Krugman, P., (1991), Increasing Returns and Economic Geography, *Journal of Political Economy*, 3:483-99.
- Lucas, R.E., (1988), On the mechanics of economic development, *Journal of Monetary Economics* 22: 3-42.
- Luger, I.M., and Evans, N.W., (1988), Geographic Differences in Production Technology, *Regional Science and Urban Economics* 18:399-24.

- Malul, M., (2009), Older workers' employment in dynamic technology changes, *Journal of Socio-Economics*, 38(5):809-13.
- Malul, M. and Bar-El, R., (2009), The Gap between Free Market and Social Optimum in the Location Decision of Economic Activity, *Urban Studies*, 46(10):2045-59.
- Malul, M. and Luski, I., (2009), The Optimal Policy Combination of the Minimum Wage and the Earned Income Tax Credit, *The B.E. Journal of Economic Analysis & Policy* (Contributions), 9(1): Article 51.
- Möller, J., (2002), The Spatial Allocation of Skills and the Agglomeration Differential, (Mimeo), University of Regensburg.
- Rauch, J. E. (1993), Productivity Gains from Geographic Concentration of Human Capital: Evidence from the Cities, *Journal of Urban Economics*, 34:380-400.
- Segal, D., (1976), Are There Returns to Scale in City Size, *Review of Economics and Statistics* 58(3):339-50.
- Shindo, Y., (2010), The effect of education subsidies on regional economic growth and disparities in China, *Economic Modeling*, 27: 1061-1068.
- Stratton, L.S. and Wetzel, J.N, (2008), Increasing Returns to Education and Progress towards a College Degree, Working Papers 0805, VCU School of Business, Department of Economics.
- Taylor, J., (1993), An Analysis of the Factors Determining the Geographical Distribution of Japanese Manufacturing Investment in the UK 1984-9, *Urban Studies*, 30(7), 1209-122.

Figure 1: The Gap in Wages between the Core Region and the Periphery (assume $\delta = 1$ in the periphery and $\alpha = 2$)

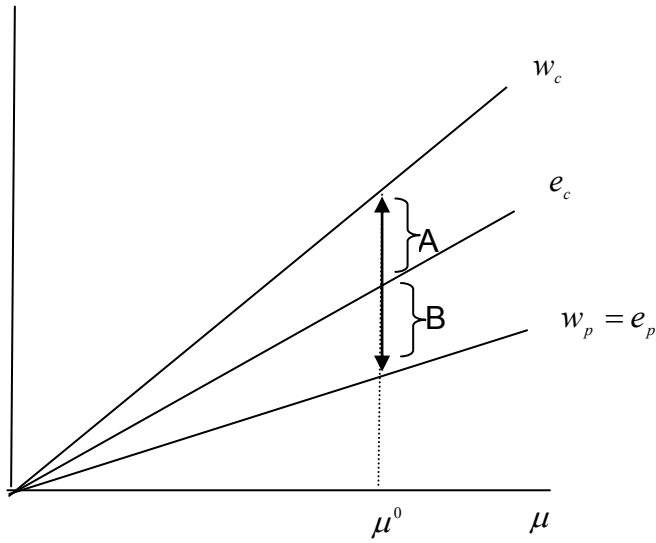


Figure 2: Employment Gap between the Core Region and the Periphery (for $\alpha = 2$)

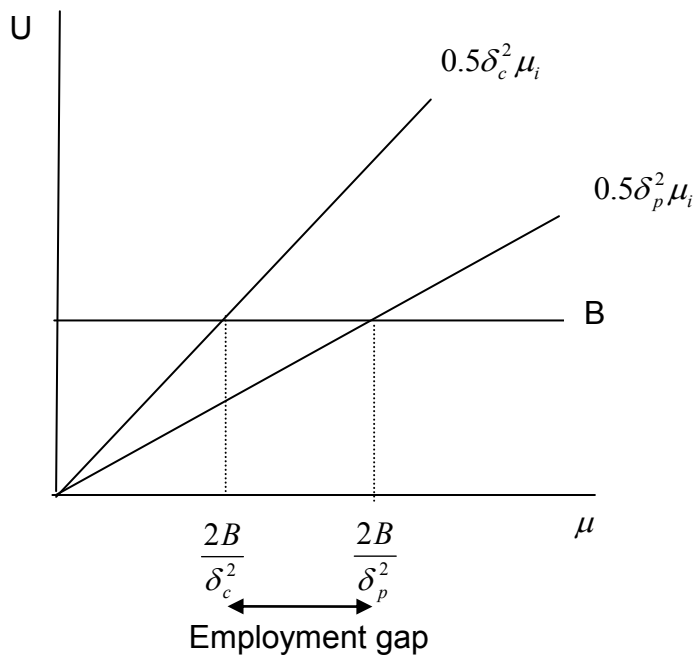


Figure 3: The Impact of “Delta” on Gaps in Unemployment, Wages and Education between the Regions

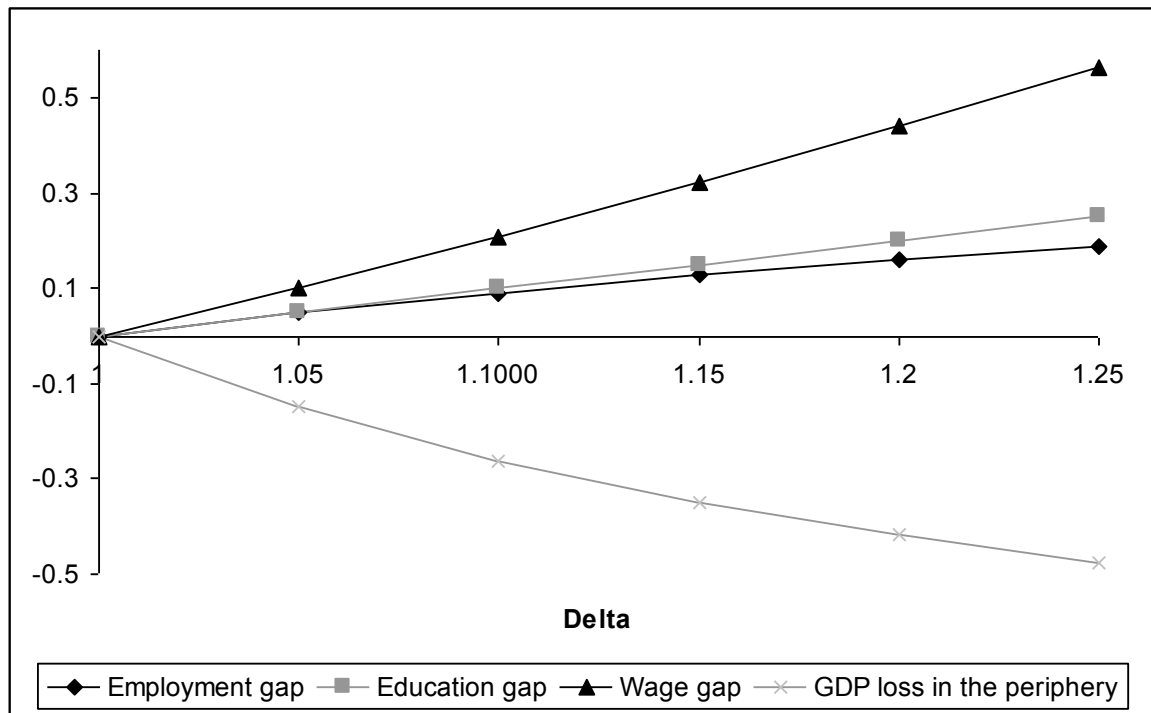


Table 1: Simulation Results

LAMDA	1.05	1.1	1.15	1.2	1.25
Employment gap	4.9%	9.1%	12.8%	16.0%	18.8%
Education gap	5.0%	10.0%	15.0%	20.0%	25.0%
Wage gap	10.3%	21.0%	32.3%	44.0%	56.3%
GDP loss in the periphery	-15.0%	-26.2%	-34.9%	-41.9%	-47.6%