Department of Economics
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ECON239: Development Economics
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Midterm Exam — Answer Guide
Monday November 2, 2009

Section A (50 percent)**:** Discuss the validity of THREE (3) of the following statements. In your answer define or explain as precisely as possible any terms or concepts which are underlined, with particular reference to the context in which they are being used. You should aim to make your answer no longer than a single side (two sides if double-spaced), and you should include diagrams and/or real-world examples where appropriate. All questions have equal value.

A1. Cross–country comparisons of real GNI per capita converted into US dollars at official exchange rates are a misleading indicator of relative standards of living.
Real GNI per capita refers to the gross national income of an economy adjusted for inflation and divided by the population. This is the index that is most commonly used to measure the average income of a country's citizens (*2 marks*). Market (official) exchange rates are simply the currency exchange rates that we see quoted everyday. These are the price of one currency in terms of another and reflect the relative supply of and demand for any two currencies (*2 marks*).

Using official exchange rates will tend to overstate differences in average living standards across countries. The reason is that market exchange rates largely reflect currency trade that it is undertaken to buy and sell goods and services across borders. By definition, this implies that these exchange rates will reflect the relative prices of traded goods (e.g. airline tickets), and not those of non–traded goods (e.g. haircuts, restaurant meals). Now the prices of non–traded goods tend to be a lot lower in developing countries than in developed countries relative to traded goods. This largely reflects the lower costs of production (mainly local wages) in poorer countries (*2 marks*). To correct for this PPP exchange rates are used. The PPP exchange rate between two countries is computed as the relative cost of an equivalent and representative basket of goods in the two countries, where the basket includes both traded and non-traded goods (*2 marks*). Using PPP exchange rates reduces the implied differences in standards of living between rich and poor countries, because it takes into account the fact that non–traded goods are cheaper in poor countries, so that the cost of living is lower (*1 marks*). If the proportion of total expenditure that is spent on each good/service were exactly the same in different countries, PPP exchange rates would be an exact measure of the relative costs of living. However since, in fact, the relative amounts of different goods consumed in different countries is not exactly the same, in practise,

economists have used the basket of goods consumed in the US (or sometimes a world average) (*1 marks*).

A2. The poverty gap index is a better target measure of poverty then the headcount ratio because it is likely to lead to less of a bias in poverty reduction policies towards individuals who are already close to the poverty line.

The headcount ratio is simply the fraction of a given population that is below some well-defined poverty line. A commonly used international poverty line is the World Bank's $1 a day poverty line (*2 marks*). Given that the resources of policy–makers are limited, the fact that it is cheaper to shift those just below the poverty line up to it, than it is to shift up those well below it, will imply a "bigger bang for the buck" in targeting the "not–so poor" (*3 marks*). This potential bias illustrates the importance of thinking carefully about formulating target measures for policy. An alternative target measure that avoids this bias is the poverty gap index which measures the "depth of poverty": the amount of income needed to raise those below the poverty line up to it (usually expressed as a percentage of the poverty line) (*2 marks*). If this were the target measure then policies that increase the incomes of the very poor would have an equal impact on the measure as those that increase the incomes of the not-so poor (*3 marks*).

A3. While a country may not fully benefit from the discovery of a new natural resource, the average standard of living of its citizens cannot fall as a result.

A natural resource refers to any resource that is derived from the environment. Many of them are essential for our survival (e.g. oxygen) while others are used for satisfying our wants. Natural resources may be classified in different ways, but it is common to distinguish between those used in agriculture (e.g. fertile land) and those used as raw materials or energy in production (e.g. coal, iron ore, etc.) (*2 marks*). There are various ways to measure the average standard of living of citizens in an economy. However, the most commonly used is the real GNI per capita (define in A1). Another commonly used measure is the human development index which is an average of per capita GNI and indices of literacy/education and longevity (*2 marks*).

At first it may seem counter-intuitive that real per capita income growth could be negative as a result of a natural resource discovery. However, while many countries have become rich as a result of their natural resource abundance (especially due to land quality), there is evidence of a negative impact on growth in some countries. For example, between 1960 and 1990 the cross-country correlation between growth and exports of primary commodities as a share of GDP was negative (*2 marks*). There are several reasons why this "resource curse" may have arisen. One view is that citizens of a country may become over-optimistic about the future gains from resource and end up consuming too much today rather than investing. A second explanation is that a natural resource discovery may result in a re-allocation of labour and capital to the

resource sector and away from other sectors such as manufacturing.[1] This is known as the "Dutch disease". If these other sectors are important engines of long run growth, the overall impact may be negative. Perhaps the most important explanation for developing countries, however, stems from the interaction with the institutional and political environment within a country. When a valuable resource is controlled by citizens in one part of a country, conflicts can arise between various factions over who should reap the returns. These conflicts are often violent and long-lasting (e.g. the discovery of oil in Sudan fueled a 20 year civil war). Even if there is no conflict, corrupt governments may redirect factors of production to the resource sector and retain the gains for themselves (*4 marks*).

A4. The positive cross-country correlation between latitude and agricultural output per person reflects the effects of malaria risk.

The positive cross country correlation referred to in this case simply implies that those countries whose geographic centre is located at higher latitudes (i.e. further from the equator) tend to have higher agricultural output per person (*2 marks*). Malaria risk is the fraction of a country's population that is estimated by the World Health Organization to have been infected with malaria each year (2 marks). It is certainly true that malaria risk tends to be higher in countries at lower latitudes. This partly reflects climatic conditions which allow for mosquito activity all year round and which result in substantial periods of standing water. Because people are typically incapacitated when they have malaria and because there are often long term effects such as brain damage, malaria has the effect of reducing agricultural output per worker (*2 marks*). Note, however, that it could be the case that this positive correlation at least partly results from the fact that richer countries have been more successful at eradicating malaria (because they can afford to). If countries at higher latitudes are richer for some other reason, then we get a positive correlation even though malaria risk is not the cause. Other reasons for the positive correlation include direct effects of climate on the type of cereals that can be grown, soil fertility and insects (mainly associated with frost), and the impact of heat on the capacity of humans to provide effort (*2 marks*).

Recent empirical research has also found that the impact of malaria risk (and other diseases) have mostly come from the fact that it affected the nature of early colonization: where colonists faced high morality rates from disease they tended not to settle, but instead set up extractive institutions. Once the variation in institutional quality is controlled for, the direct effect of latitude and malaria risk is not significant (*1 mark*). However, Jeffrey Sachs has recently argued that these results stem from bad measurement — estimated malaria risk is based on reported cases which may not be very accurate. He presents evidence using an index of "malaria ecology" which measures the underlying factors that lead to high rates of malaria. He finds that the direct

[1] This can happen, for example, if the exchange rate appreciates dues to foreign sales of the resource and this hurts exports of manufacturing.

effects on per capita income are significant, even after controlling for the impact of institutional quality (*1 mark*).

A5. The widespread use of sharecropping despite its low productivity relative to fixed-rent tenancy may be understood once we allow for the role of asymmetric information. Sharecropping refers to a situation in which a tenant pays for the use of an owner's land by giving him a share of the output that results from his labours (*2 marks*). Unlike fixed tenancy, the effective payment varies with the level of output. As a result of sharecropping, the incentives faced by the tenant are often thought to be weak because he loses a fraction the margin return to his labour (*2 marks*). According the Chicago school however, sharecropping need not be inefficient. Rather it arises as a way of sharing risks between the landlord and tenant and thereby reduces the overall cost of risk associated with the transaction. The parties should be able to figure out what the efficient level of labour effort is and agree on a contract (*2 marks*). According to the new institutional view, however, this argument ignores the fact that labour effort is often not directly observable and cannot be inferred from the output level when there is risk. In other words, this is a situation of asymmetric information (moral hazard) in which the landlord cannot observe a crucial action of the tenant (*2 marks*). In this situation, there is a trade-off between incentives and risk: as the share the tenant receives increases, his incentives to provide effort improve but the risk he faces increases. Because of this trade-off it is too costly to have a fixed-rent contract because the tenant would face all the risk. As a result, sharecropping emerges as the least costly way to arrange the transaction, even though it involves lower productivity (*2 marks*).

Section B (50 percent)**:** Answer ONE (1) of the following **Long Questions.**

B1. **Consider the following version of the augmented Solow growth model. Suppose the relationship between output per worker, y, physical capital per worker, k, and human capital per worker, h, at any point in time is represented by**

$$y = f(k, h),$$

where the function $f(\cdot)$ is increasing in k and concave. Suppose also that there is no technological change, population growth is n, the savings rate is s and the rate of depreciation of capital is δ.

(a) Explain intuitively why the dynamic evolution of k is described by the equation

$$\Delta k = sf(k, h) - (n + \delta)k.$$

In the absence of any new investment, capital per worker would decline over time because of physical depreciation and because the size of the workforce is growing over time. The term $(n + \delta)k$ represents the amount of investment that is just required to stop the capital stock per worker from declining. As can be seen it is increasing in the population growth rate and the rate of depreciation. It is also proportional to the existing capital stock per worker, since the bigger this is the more investment is needed to stop it from declining. The term $sf(k, h)$ represents the actual investment per worker made in the economy, which is equal to the savings per worker. The equation basically says that the capital stock per worker will grow whenever the actual investment exceeds its "break–even" level, and will fall otherwise.

(b) With the aid of a diagram, illustrate the steady state capital stock per worker, k^*. If the initial value of k differs from k^*, illustrate the process by which the economy converges to the balanced growth path.

Figure 1 illustrates the relationships between actual investment and the capital stock per worker, and between "break–even" investment and the capital stock per worker. The steady state is a situation in which $\Delta k = 0$, which implies that k^* must satisfy

$$sf(k^*, h) = (n + \delta)k^*$$

This is simply the value of k at which the actual and break–even investment curves intersect.

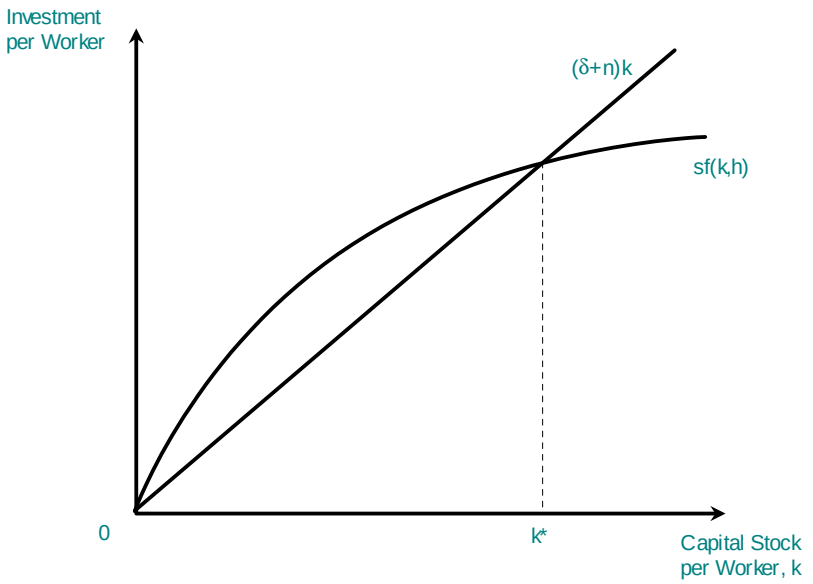

Figure 1: Steady State

Suppose that the initial value of k is $k_0 < k^*$, as illustrated in Figure 2. As the diagram shows, at such a low level of k, that actual investment exceeds its break–even level and, consequently, the capital stock will grow to k_1, say. Since $k_1 < k^*$, the same argument holds and the economy will

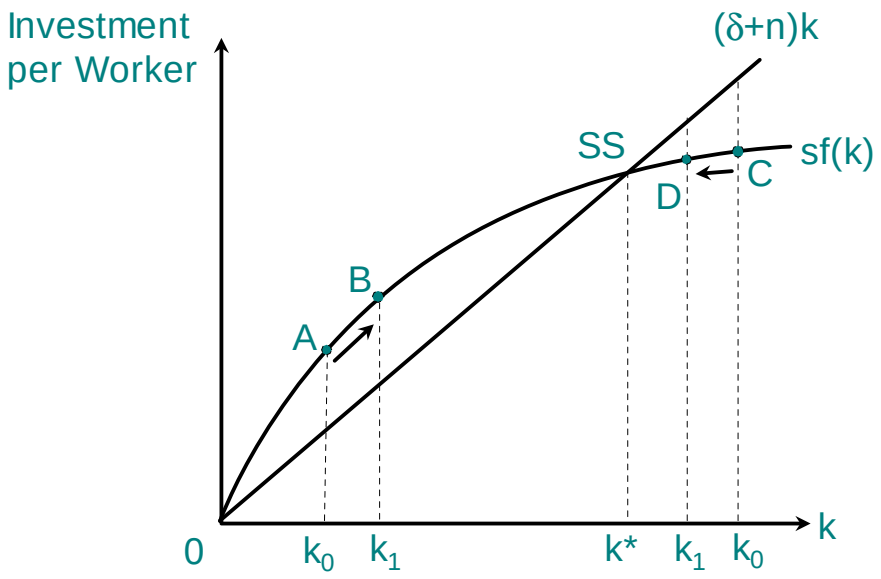

Figure 2: Dynamics of the Solow Model

continue to grow. This process will continue as long as $k < k^*$ and so it follows that the economy converges to the balanced growth path. A similar argument applies starting from an initial value of k that exceeds k^*.

(c) Illustrate on a diagram the impact of an increase in the stock of human capital, h, on the level of output per capita along the balanced growth path. Describe how the economy adjusts from its original steady state to its new one.
As illustrated in Figure 3, an increase in human capital from h_1 to h_2 causes the savings function to shift up for every level of k. The balanced growth path shifts from S_1 to S_2 and the capital stock per worker rises from k_1^* to k_2^*. Since output per worker depends positively on both k and h, it must also increase. The adjustment process is as follows. When h increases, then for a given capital stock per worker, savings exceed the break-even level of investment. Consequently, the capital stock grows. As long as we are below the new steady state, the capital stock then continues to grow until the economy reaches it.

(d) Under the neoclassical assumption that wages are proportional to human capital, explain how you might go about estimating relative human capital across countries.
From country studies it is possible to determine the approximate relationship between wages and years of education. Typically each additional year of education adds, on average, an additional x% to wages, where x tends to decline as years of schooling increases (i.e. diminishing returns). Given this and the assumption stated above, we can derive an index of relative human capital using observations of the average years of education in each country. For example, if country A's average years of schooling exceeds country B's by 1 year, then their relative human capital can

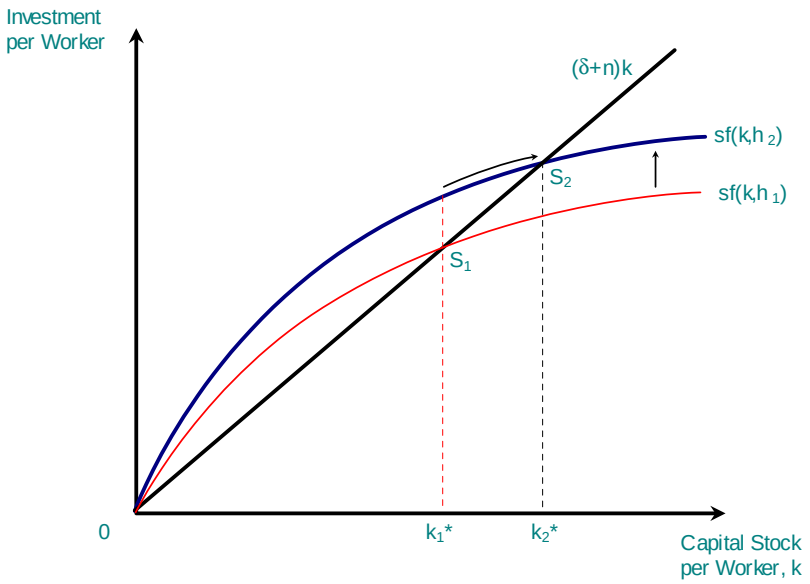

Figure 3: Impact of increase in h

be expressed as

$$\frac{h_A}{h_B} = 1 + x$$

(e) Consider two countries that have the same production function

$$y = k^{\frac{1}{2}} h^{\frac{1}{2}}$$

and equal values of $s = 0.2$, $n = 0.02$ and $\delta = 0.08$. If one of these countries has twice the human capital of the other, what does this imply for their relative per capita outputs in steady state?

In steady state the capital stock must satisfy

$$sk^{\frac{1}{2}} h^{\frac{1}{2}} = (n + \delta)k.$$

Solving for k we get

$$k = \left(\frac{s}{n+\delta}\right)^2 h = \left(\frac{0.2}{0.1}\right)^2 h = 4h$$

It follows that output per capita is

$$y = (4h)^{\frac{1}{2}} h^{\frac{1}{2}} = 2h$$

Consider two countries, indexed 1 and 2. We can express their relative per capita outputs as

$$\frac{y_1}{y_2} = \frac{h_1}{h_2}.$$

Hence, if country 1 has twice the human capital of country 2, it will also have twice the output per capita.

B2. A plot of land is owned by a Landlord but worked by a Tenant. If the Tenant provides effort L she incurs a cost $C(L)$, which increases at an increasing rate with L. The value of output from the plot is given by the production function

$$y = g(L) + x,$$

where $g(L)$ increases at a decreasing rate with L, and x represents random variations in output due to climatic conditions. The Landlord can observe the output produced by the Tenant, but cannot monitor or infer the amount of effort she exerts.

(a) Using the above information, write down the incomes of the two parties under (1) a wage contract, (2) a rental contract and (3) a sharecropping contract.

The Tenant's income is : $I_t = -F + (1-\alpha)[g(L) + x] - C(L)$.

The Landlord's income is : $I_l = F + \alpha[g(L) + x]$.

The contract specifies alternative values of F and α, *before* the two parties know what the value of x will be. We can represent three alternative types of contract in this framework:

(1) A **wage contract** : $F < 0$ and $\alpha = 1$

– the Landlord pays a fixed wage, $-F$, to the Tenant in return for a specified level of effort and receives all the output herself. The wage is determined in the labour market.

(2) A **rental contract** : $F > 0$ and $\alpha = 0$

– the Tenant rents the plot from the Landlord for a fixed amount F and receives all the output himself. The rent is determined in the land rental market.

(3) A **sharecropping contract** : $F =?$ and $0 < \alpha < 1$.

– the two parties divide up the output, with the Tenant getting a share $1 - \alpha$ and the Landlord receiving α. A fixed payment, F, may also be made from one party to the other, the net value of which will depend upon market wages and rental rates. However, this contract is not a pure market contract: factors other than price matter.

(b) In each of these contracts describe how the risk is allocated between to two parties. What about the incentives faced by the Tenant to exert effort ?

(1) In the wage contract, the Landlord faces all the risk and the Tenant none, but the incentives faced by the Tenant are weak.

(2) In the rental contract, the incentives faced by the Tenant are strong, but he now bears all the risk and the Landlord bears none.

(3) In the share–cropping contract, both parties bear some risk. The smaller the value of α, the more risk the Tenant faces and the less is borne by the Landlord. The incentives faced by the Tenant are weaker than under a rental contract but stronger that under the wage contract, and decrease with α.

Assume that the Landlord is risk–neutral, but the Tenant is risk–averse. This risk-aversion is represented as a cost which increases at an increasing rate with the Tenant's share of output.

(c) With the aid of a diagram, explain how the theoretical constrained–efficient output share received by the Tenant, $1-\alpha^*$, and the associated effort level, L^*, are determined in a sharecropping contract.
Given the parameters of the contract, α and F, the Tenant will choose his effort level so that his private marginal cost equals his private marginal benefit:

$$MC(L) = (1-\alpha)MB(L).$$

This is the Tenant's **incentive constraint**: it tells the Landlord how he will have to increase the output share $1-\alpha$ in order to encourage more effort. In particular, $1-\alpha$ is an increasing function of the desired effort level. However, the increase in $1-\alpha$ needed to attain more effort, also increases the cost of risk faced by the Tenant. The increment in the cost of risk necessary to attain each additional unit of effort is given by the marginal cost of risk (MCR) curve illustrated in Figure 4.

The incentive–constrained or second–best efficient value of α is the one where the gains and losses of decreasing it any further are just equalized, α^*. For any $\alpha > \alpha^*$ the increase in productive efficiency resulting from an increase in the share exceeds the increase in the cost imposed due to additional risk. For any $\alpha < \alpha^*$ the reduction in productive efficiency resulting from an decrease in the share is less than the decrease in the cost imposed due to additional risk. When $\alpha = \alpha^*$, the reduced production efficiency loss caused by increasing the share, AB, is just equal to the additional welfare cost due to risk, CD.

(d) Using the same diagram as in (c) illustrate the total losses (due to bad incentives and risk) under the sharecropping contract, relative to the full–information case.
The efficiency (i.e. welfare) losses are represented by the shaded areas in Figure 4.

(e) Suppose the government introduces a crop insurance program and assume that the only effect of this is to lower the Tenant's marginal cost of risk by a constant proportion at each level of effort. According to the above theory, how would this affect the constrained–efficient share ? Explain your answer using a diagram.
As illustrated in the lower panel of Figure 5, the MCR curve shifts down. Now the original share received by the Tenant, $1-\alpha_0^*$, is no longer constrained efficient – a small reduction in α will reduce the efficiency loss by more than the increase in the cost of risk. To find the new constrained–efficient share, just reduce α (thereby shifting up the effective marginal benefit accruing the tenant) until the marginal efficiency loss is just equal to the marginal cost of risk. That is where $A'B' = C'D'$. This yields the new constrained-efficient share accruing to the tenant, $1-\alpha_1^*$, which is now higher due to the crop-insurance program.

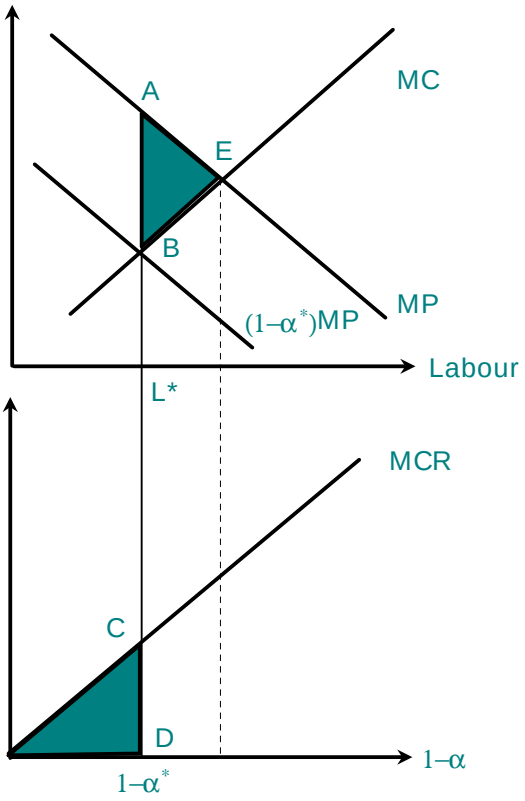

Figure 4: Constrained-efficient Sharecropping Contract

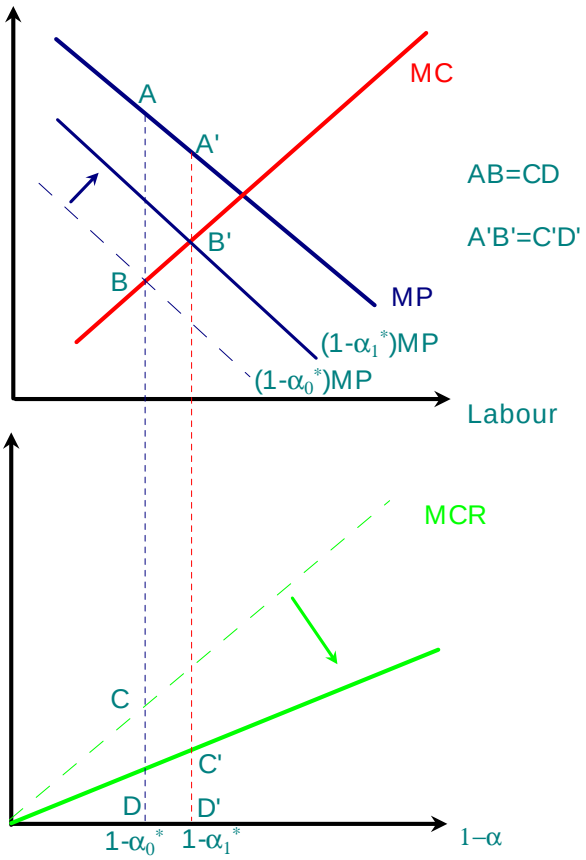

Figure 5: Effect of Reduction in Risk due to Crop Insurance