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## Trade Policy and Risk Diversification<sup>1</sup>

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### Abstract

The paper analyses the influence of trade policies on the investment decisions of a representative individual. In particular, the increased uncertainty of future income is considered in the investment behaviour of individuals. The optimal portfolio-decision of a representative working individual is analysed in comparison to a non-working shareholder.

The paper finds an important influence from trade policy on the saving and investment behaviour of a working individual. Yet the optimal demand for an asset does not always increase if a protectionist trade policy is introduced in the corresponding sector as might be expected. The asset covariance and the labor risk correlation, especially the working location of the individual, determine the final results of the investment decision and can even reverse the expected effect from protection. Moreover, a effective hedge for the income risk is not possible in most of the observed scenarios.

**JEL classification:** F13, F16

**Keywords:** Protection, Portfolio Choice, Risk Diversification, Income Risk

### 1. Introduction

Among many other institutions, the Doha round has reconfirmed the call for free trade. Actually since the mid 60s there is a substantial integration of trade<sup>2</sup>. Associated with trade liberalization is a loss of protection and as a consequence higher profit risk for many sectors and individuals working in these sectors. On the other hand we observe a continuing development of financial markets<sup>3</sup>. Unrestrained financial markets can be used to diversify financial and non-financial risk. Hence financial markets can work as an insurance instrument. So as financial markets may absorb the newly raised risk by trade liberalization there might be a connection between trade liberalization and financial integration. Svaleryd and Vlachos (2002) show empirically that there is a significant link financial development and trade liberalization. They find neither an unambiguous direction nor an explanation for this observed dependency. However there are different approaches with various possible explanations of the forces affecting the link between trade

<sup>1</sup>The mathematical appendix will be available soon on my personal homepage: <http://www.uni-siegen.de/~fb05pfe/pfeffer.html>

<sup>2</sup>See for example Wei and Wu (2002).

<sup>3</sup>For empirical evidence on this development see for example Prasad, Rogoff, Wei and Kose (2003).

liberalization and financial integration in both directions<sup>4</sup>. Following for example Eaton and Grossman (1985) or Cole and Obstfeld (1991) financial openness enforces trade liberalization for goods. They argue that risk diversification via financial markets substitutes for the insurance effect of protectionist trade policy. Additionally Feeney and Hillman (2004) show in an political economical approach how increasing risk diversification over asset markets reduces the demand for protectionist trade policy.

Following these considerations I come to the conclusion that the continuing trade liberalization strengthens the desire to diversify risk - especially labor income risk - over financial markets. Thus the question raises whether protectionist trade policy reduces the individual diversification on the asset market. Moreover a stronger dependence on the personal labor income could be the consequence of the reduced diversification possibilities. I explore whether this is indeed the case.

To answer these questions I observe the influence of trade policies on the investment decisions of a representative working individual. Contrary to the mentioned literature I take the trade policy as exogenous and endogenise the individual diversification decision on the asset market. In particular, the increased uncertainty of future income is considered in the individual investment behaviour. To hedge the income risk the working individual has the possibility to invest in two different risky assets and one risk free asset. The two risky assets are shares in the industry  $x$  and  $y$  respectively with different correlations between their expected returns and varying correlations with the wage risk. Moreover, the variation of the income risk is decisive for the optimal portfolio-decision. Claims on future labour income are not tradable.

To see how the optimal portfolio-choice depends on trade policy and hence how globalization influences the portfolio choice I put the main emphasis on the influence from exogenous trade policy on the portfolio-decision. Furthermore, I evaluate if a labour income risk hedge is still possible under a protectionist trade policy.

The investment decision of my working individual is mainly determined by the asset covariance and the labor asset covariance. Furthermore the tariff impact on the covariance depends on the factor intensities, the composition of the productivity shocks and the relative prices in the two home country industries. Thus I confirm and extend the findings of Mayer (1984). Finally variations in the total risk share can dilute the results.

I find that the asset market exploitation is reduced with the introduction of an import tariff. Even though the asset market does not lose his role as insurance instrument completely the risk diversification over the asset market diminishes as a consequence of the tariff implementation. I find no definite investment concentration in the protected sector as stated by Cassing (1996). On the contrary I observe a portfolio bias towards the not protected industry.

The paper is organized as follows. In section two I give a short literature survey. Section three emphasises the production side and section four derives the individual portfolio

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<sup>4</sup>Aizenman (2003) offers an explanation for commercial openness driving financial openness. He shows that the pressure to open the financial system is a by-product of successful trade integration. Restrictions on financial markets lose their impact in the presence of increasing trade liberalization. On the other hand Tamirisa (1999) explores empirically the dependency from the opposite direction. Following her findings exchange and capital controls can act as non-tariff-barriers (ntb) to trade. The final impact of these ntb depends on the relation between trade in goods and factors and the economic pattern of the country.

decision. Section five analyses the optimal asset allocation of a working individual under a protectionist trade regime and the possible labor income risk hedge. Section six concludes the paper.

## 2. The Literature

In my analysis I link three different strands of literature.

Using the portfolio-theory I follow mainly the model of Campbell and Viceira (2003). The standard portfolio-theory analyses the portfolio decision between one risky and one risk-free asset. Correlations between the expected returns of the risky assets are often neglected. In my analysis the second risky asset is very important to emphasize the effects of the trade policy and possibilities of the income hedge. With the second risky asset we can explore whether the tariff implementation causes a rebalancing of the portfolio composition and how the asset allocation changes between the protected and the not protected industry. Furthermore, the second risky asset allows for combining two different views of capital income as an alternative income source for a working individual and thus leads to literature dealing with the correlation between wages and capital income.

The effects of a positive correlation between wage and capital income were first shown by Weitzman (1984) and further developed by Renström and Roszbach (1995). They observe positive productivity effects that lead to more employment if workers prefer to hold shares of the company they work for. Harms and Hefeker (2003) analyse the effects of an alternative capital income that is negatively correlated with labour income of workers (union members) on employment. They also conclude that this results in a reduction of unemployment.

These different results of additional capital income justify the variation of the income risk correlation. Thus I analyse which investment alternative will be preferred by the representative individual under the different trade regimes.

The third strand of literature finally links trade liberalization and asset market development. Feeney and Hillman (2004) as well as Eaton and Grossman (1985) demonstrate that complete capital markets offer diversification of risks and decrease the demand for a protectionist trade policy. However, this impact of the joined development of capital markets and trade liberalization is not unambiguous the opposite argument is found as well: Trade liberalization raises the need for risk diversification over the capital market. As a consequence, the increased insurance demand enforces the development of the capital-markets. Empirically, there is no definite empirical support for neither of the arguments (Svalery and Vlachos (2002))<sup>5</sup>.

One contribution of the present paper to the existing literature and especially to this strand is that I show whether and how a protectionist trade regime changes the savings behaviour of a working individual and influences its willingness to invest in the capital market. Therefore I revert the statement of Feeney and Hillman (2004) and use a portfolio approach to confirm or disapprove their political economical results.

Cassing (1996) observes the portfolio-allocation of a shareholder without working income in dependence of the trade regime. In contrast to this, my second contribution is

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<sup>5</sup>Additional explanations for the liberalization of commodity trade as driving force of financial openness are found for example by Aizenman (2003).

the observation of the portfolio-decision of a working individual with a risky wage.

All in all I use a more general approach than the mentioned literature with exogenous trade policy and endogenous investment decision. My results depart from the literature in the following way: I can not confirm a general statement about a stimulating effect on the asset market caused by trade liberalization. Precisely I show that the respective country pattern (which industries are hosted in the country and how are they related) and the position of the representative investor (willingness to bare risk and where does he work) are decisive for the final impact of trade liberalization on asset market activities in different countries.

### 3. Production

The analysis is based on a standard Heckscher-Ohlin model, where a small open country trades with the rest of the world at exogenous terms of trade. The industry in the home country produces two final consumption goods  $x$  and  $y$ .  $y$  is the export and  $x$  is import-competing good. The production of good  $x$  is labor intensive and that of good  $y$  is capital intensive. The world prices at time  $t$  are given by  $p_{i,t}$ ,  $i = x, y$ . The government in the home country implements a tariff  $\tau$  on good  $x$ . Hence the relative prices for good  $x$  and for good  $y$  in the home country are  $p_{x,t}(1 + \tau_{t,x})$  and  $\frac{p_{y,t}}{(1+\tau_{x,t})}$  respectively.

Each industry in the home country consists of identical domestic firms using the same technology. The representative production function is:

$$(1) F_{i,t}(L_{i,t}, K_{i,t}) = \phi_{i,t}^s K_{i,t}^{\beta_i} L_{i,t}^{1-\beta_i} \quad \text{with } i = x, y$$

$K_{i,t}$  is the amount of capital and  $L_{i,t}$  the amount of labor employed in the production process in industry  $i$  at time  $t$ . Production in both industries is affected by stochastic productivity shocks  $\phi_{i,t}^s$  realised in period  $t$  whereas  $s$  specifies one definite realization of  $\phi_{i,t}$  in  $i$ . There are many different possible realizations of  $\phi_{i,t}^s$  and they occur with probability  $q_{i,t}^s$ , the values of these shocks are strictly positive and iid. In particular a positive productivity shock is realised if  $\phi_{i,t}^s > 1$  and a negative one if  $\phi_{i,t}^s < 1$ , with  $\phi_{i,t}^s = 1$  there is a shock free situation. Moreover, the occurrence of a specific productivity shock in sector  $x$  can be positively or negatively correlated with the appearance of a specific productivity shock in sector  $y$  and vice versa. Hence for the joint probability of a simultaneous occurrence of  $(\phi_{x,t}^s; \phi_{y,t}^s)$  yields  $q_{xy,t}^s \neq q_{x,t}^s q_{y,t}^s$ .

As a consequence the factor income is stochastic too. With perfect perfect competition on product and factor markets the domestic income for labor and capital respectively is:

$$(2) w_{i,t} = p_{i,t} (1 - \beta_i) \phi_{i,t}^s K_{i,t}^{\beta_i} L_{i,t}^{-\beta_i}$$

$$(3) r_{i,t} = p_{i,t} \beta_i \phi_{i,t}^s K_{i,t}^{\beta_i-1} L_{i,t}^{1-\beta_i}.$$

## 4. Portfolio Decision of the Worker

I consider a risk averse individual through the complete analysis. The optimization problem of the individual is closely linked with the aim to hedge future income risk from labor. This will be shown by solving the optimization problem. I derive the optimal asset choice for different constellations of risk. To observe the hedging problem more clearly it is necessary to define the different available income sources in more detail.

### 4.1. Income sources

The representative individual contributes a fixed fraction of his time to work. Normalized to one, labor income  $w_{i,t}$  is defined as in (2).

In addition to the labor income the individual has the possibility to generate capital income in period  $t + 1$ . The individual is endowed with an initial amount of fixed wealth  $V_t$ . The earned labor income in period  $t$  not spent on consumption is included in  $V_t$ . Shares of  $V_t$  can be invested during period  $t$  in two risky assets  $\alpha_{i,t}$  (shares of industries) with return  $r_{i,t+1}$  and in the riskfree asset with constant return  $r_f$ . Therefore the total portfolio return in  $t + 1$  will be

$$(4) \quad r_{p,t+1} = \alpha_{x,t} r_{x,t+1} + \alpha_{y,t} r_{y,t+1} + \alpha_{f,t} r_f,$$

where

$$(5) \quad 1 = \alpha_{x,t} + \alpha_{y,t} + \alpha_{f,t}.$$

Assuming that there are no short-sales  $\alpha_{i,t} \geq 0$ , and that  $\alpha_{i,t}$  refers to a proportionate share in the total available wealth portfolio return in  $t + 1$  can be rearranged as

$$(6) \quad r_{p,t+1} = \alpha_{x,t} (r_{x,t+1} - r_f) + \alpha_{y,t} (r_{y,t+1} - r_f) + r_f$$

The risky asset returns and the portfolio return are assumed to be lognormally distributed<sup>6</sup>. Thus defining  $\delta_{i,t+1} \equiv \ln(1 + r_{i,t+1})$  and  $\delta_f \equiv \ln(r_f + 1)$  the modified portfolio return in  $t + 1$  is

$$(7) \quad \delta_{p,t+1} = \alpha_{x,t} \delta_{x,t+1} + \alpha_{y,t} \delta_{y,t+1} + \alpha_f \delta_f.$$

Defining  $u_i$  and  $\sigma_i^2$  as mean and variance, the expected log excess return is defined by

$$(8) \quad E_t(\delta_{i,t+1} - \delta_f) = E_t(\delta_{i,t+1}) - \delta_f \equiv \mu_i.$$

The labor income is also lognormally distributed and  $l_{i,t+1} \equiv \ln w_{i,t+1}$  is the log labor income generated in sector  $i$  with expected mean  $\mu_l$  and variance  $\sigma_l^2$ <sup>7</sup>.

<sup>6</sup>A lognormal distribution results if the variable is the product of a large number of independent, identically distributed variables, in this model  $\phi_{i,t}$ . Therefore the lognormal distribution is usually used to demonstrate asset return distribution. For further details see Aitchison and Brown (1973) or Pflaumer, Heine and Hartung (2001).

<sup>7</sup>For a detailed derivation of the means and variances of these variables see appendix 1.

## 4.2. The Worker's Problem

To derive the investment decision of the working individual, I use a one horizon investment decision model. Consider a risk-averse individual with constant relative risk aversion coefficient  $\gamma > 1$ <sup>8</sup> close to Campbell and Viceira (2003)<sup>9</sup>. The individual has an initial endowment of wealth  $V_t$  in period  $t$  including the realised labor income in this period. In period  $t$  the individual decides which share of  $V_t$  to consume and which share  $\alpha_i$  to invest in which industry. In particular the realisation of the portfolio return in period  $t + 1$  in addition to  $w_{i,t+1}$ , is supposed to maximize the consumption of this individual with time preference  $\theta$  in period  $t + 1$ :<sup>10</sup>

$$(9) \quad \max_{\alpha_{x,t}, \alpha_{y,t}} E_t \left[ \theta \frac{C_{t+1}^{1-\gamma}}{1-\gamma} \right].$$

subject to the budget constraint and referring to (6)

$$(10) \quad C_{t+1} = V_t (1 + r_{p,t+1}) + w_{i,t+1}.$$

The worker chooses his asset allocation today to maximize his consumption tomorrow. He chooses his optimal portfolio to yield the highest possible return with respect to his risky labor income and the prevailing trade policy.

To obtain an analytical solution it is necessary to apply the loglinear solution methods analog to Cambell and Viceira (2003) and extend them properly to the underlying model. Therefore all involved quantities are assumed to be positive. As a result of the utility function choice  $C_{t+1}$  is positive anyway. In addition to the definitions already noted above in the following lowercase letters refer to the log of the uppercase variables.

First the log linearized portfolio return on wealth is computed from (6). Rearranging (6) and taking logs on both sides yields

$$(11) \quad \delta_{p,t+1} - \delta_f = \ln [1 + \alpha_{x,t} (\exp(\delta_{x,t+1}) - 1) + \alpha_{y,t} (\exp(\delta_{y,t+1}) - 1)].$$

Further implementing a second-order Taylor expansion with two variables around the point  $\delta_{p,t+1} - \delta_f = 0$  results in <sup>11</sup>

$$(12) \quad \begin{aligned} \delta_{p,t+1} &= \alpha_{x,t} (\delta_{x,t+1} - \delta_f) + \frac{1}{2} \alpha_{x,t} (1 - \alpha_{x,t}) \sigma_x^2 + \alpha_{y,t} (\delta_{y,t+1} - \delta_f) \\ &+ \frac{1}{2} \alpha_{y,t} (1 - \alpha_{y,t}) \sigma_y^2 + \alpha_{x,t} \alpha_{y,t} cov(\delta_{x,t+1}; \delta_{y,t+1}) + \delta_f. \end{aligned}$$

<sup>8</sup>Heaton and Lucas (2000b) use a similiar life cycle model but with more than two periods. They set  $\gamma$  at 5 and 8 for a sufficient risk avers investor. On the other hand Bertaut and Haliassos (1997) consider  $\gamma$  to take the value 3 for their benchmark life-cycle model without bequest.

Further Heaton and Lucas (1997) derive different levels of risk aversion for CRRA investors.

<sup>9</sup>A similiar model for a longer time horizon is used by Heaton and Lucas (2000b), to analyse the impact of background risk on the portfolio choice.

<sup>10</sup>For the motivation to use this kind of utility function and its specific reaction to background risk see Gollier (2001).

<sup>11</sup>For specific mathematic details see Appendix. For generell discussions on this topic see Campbell and Viceira (2001) and Hardy and Walker (2003).

The next step is to loglinearize the budget constraint. Hence both sides of (10) are divided by  $w_{i,t+1}$  and logs are taken

$$(13) \quad c_{t+1} - l_{i,t+1} = \ln(\exp(v_t - l_{i,t+1} + \delta_{p,t+1}) + 1).$$

Thus the log optimal consumption

$$(14) \quad c_{t+1} \approx g + \rho(v_t + \delta_{p,t+1}) + (1 - \rho)l_{i,t+1}$$

with  $g$  and  $\rho$  as loglinearization constant can be derived<sup>12</sup>.  $\rho$ <sup>13</sup> can be interpreted as the consumption elasticity with respect to financial wealth whereas  $(1 - \rho)$  can be seen as the consumption elasticity with respect to labor income.

The log optimal future consumption is a weighted average of future financial wealth and future labor income each weighed with the consumption elasticity with respect to financial wealth and labor income respectively. These weights are important for the further decision process because they also affect the importance of the different risk sources. For instance, with  $\rho > 0,5$  variations in the labor income have only a very small effect on consumption changes. On the other hand changes in the financial wealth then have a big impact on the consumption decision. This can be a very interesting distinction for cases where financial wealth and labor income are negatively correlated in the final portfolio decision<sup>14</sup>.

To reach the optimal portfolio decision the first order condition of the problem has to be observed<sup>15</sup>:

$$(15) \quad E_t(\theta C_{t+1}^{-\gamma}(r_{i,t+1} + 1)) = E_t(\theta C_{t+1}^{-\gamma}(r_f + 1)).$$

The first order condition shows that the expected total return of the investment from the value of  $C_{t+1}^{-\gamma}$  in industry  $x$  during period  $t$  has to be the same as the investment from the value of  $C_{t+1}^{-\gamma}$  in industry  $y$  or the risk free asset in  $t$ . In particular foregone consume in  $t + 1$  must be compensated through an additional gain in financial wealth in  $t + 1$  independently of the chosen investment alternative. The first order condition is also log linearized and a second order Taylor expansion is implemented around the conditional means of  $c_{t+1}$  and  $r_{i,t+1}$ . Substituting (14) for  $c_{t+1}$  and rearranging gives

$$(16) \quad \mu_i + \frac{1}{2}\sigma_i^2 = \gamma[\rho(\alpha_{i,t}\sigma_i^2 + \alpha_{j,t}\sigma_{i,j}) + (1 - \rho)\sigma_{i,l}] \quad \text{with } j = x, y \neq i.$$

For simplicity the following observations are made for investments in industry  $x$ . But these observations and results hold analog for investment decisions in industry  $y$ . Now

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<sup>12</sup> $\rho \equiv \frac{\exp(\delta_p + v - l_i)}{1 + \exp(\delta_p + v - l_i)}$

For mathematic details see Appendix.

<sup>13</sup>Per definition  $0 < \rho < 1$ .

<sup>14</sup>This impact of  $\rho$  on the consumption decision even gains on interest if the labor decision is endogenized, by Jermann (1998).

<sup>15</sup>This first order condition is confirmed by the general consumption decision model under uncertainty by Drèze and Modigliani (1972).



solving (16) for  $\alpha_{x,t}$  leads to the asset allocation in industry  $x$

$$(17) \quad \alpha_{x,t} = \frac{1}{\gamma\rho} \frac{\mu_x + \frac{1}{2}\sigma_x^2}{\sigma_x^2} - \frac{\alpha_{y,t}\sigma_{x,y}}{\sigma_x^2} - \frac{(1-\rho)}{\rho} \frac{\sigma_{x,l}}{\sigma_x^2}.$$

In (17) the optimal decision  $\alpha_{x,t}$  is a simultaneous decision with  $\alpha_{y,t}$ . Using (5) this can be rewritten as

$$(18) \quad \alpha_{x,t} = \frac{1}{\gamma\rho} \frac{\mu_x + \frac{1}{2}\sigma_x^2}{\sigma_x^2 - \sigma_{x,y}} - \frac{f\sigma_{x,y}}{\sigma_x^2 - \sigma_{x,y}} - \frac{(1-\rho)}{\rho} \frac{\sigma_{x,l}}{\sigma_x^2 - \sigma_{x,y}}.$$

Where  $f \equiv (1 - \alpha_{f,t})$ . Hence  $f$  indicates the total proportion of risky assets in the portfolio<sup>16</sup>. Obviously the optimal asset allocation for investments in industry  $x$  can be divided into three components. The first term on the right hand side corresponds to the decision of an investor in the standard mean-variance analysis<sup>17</sup>. To see this connection more clearly it is important to reconsider an important property of a lognormal distributed variable, namely

$$(19) \quad \log E_t (r_{i,t+1} + 1) = E_t \log (r_{i,t+1} + 1) + \frac{1}{2} \text{var} \log (r_{i,t+1} + 1).$$

So the portfolio decision in this case given a specified risk-aversion depends mainly on the mean and variance ratio of the log excess return of asset  $x$ . Further the second risky asset and the labor risk have an impact on  $\alpha_{x,t}$ .

The impact of the second risky asset is not unambiguous. Under the assumption of a positive correlation between the risky assets in the first term the joined risk of the two risky assets mitigates the pure risk of asset  $x$  (positive direct impact). With negative correlations between the risky assets the joined risk enforces the risk affect of asset  $x$  (negative direct impact). This joined risk effect also impacts the labor risk hedge component of the optimal asset allocation for asset  $x$ .

Moreover the additional risk through the implementation of a second asset  $y$  does not necessarily lead to a rebalancing of the portfolio between asset  $x$  and  $y$ . Independently of the correlation of the two risky assets the additional risk may also decrease the shares in  $x$  and  $y$  and raise the share invested in the risk free asset. Gollier and Schlee (2004) show that in a two risky asset case the increase of the expected dividend of one asset does not necessarily always causes an increase in the demand for this asset. Thereby the correlation between the two risky assets is irrelevant.

## 5. Risk Diversification under Protectionist Trade Policy

In this section I introduce an exogenous tariff in industry  $x$  and derive the portfolio decision especially the hedging of the labor income risk. Following Feeny and Hillman

<sup>16</sup>In turn  $1 - f$  states the proportion of the risk free asset in the chosen portfolio.

<sup>17</sup>For a detailed derivation of the mean-variance method see Markowitz (1987).

(2004) an unrestrained access to asset markets lowers the individual demand for a protectionist trade policy. Further they show that even in a state of an imperfect asset market and therefore partly restricted risk diversification the demand for a protectionist trade policy is reduced. In this situation lobbying for a tariff only occurs if the import competing sector is sufficient large. Conversely the introduction of a protectionist trade policy is supposed to lead to less use of asset markets.

Cassing (1995) finds that the introduction of a tariff in one sector induces a concentration of the investments in the protected sector in the case of negatively correlated sectors. In contrast to the present paper he considers an investor who only owns capital income.

To confirm or reject one of these findings I introduce an exogenous trade policy in the model above. In period  $t + 1$  a positive tariff on import goods is imposed in industry  $x$ ,  $\tau_{x,t+1}$ . Hence the relative price in the home country for goods produced in industry  $x$  changes from  $p_{x,t+1}$  to  $p_{x,t+1}(1 + \tau_{x,t+1})$  and for goods produced in industry  $y$  from  $p_{y,t+1}$  to  $\frac{p_{y,t+1}}{(1+\tau_{x,t+1})}$  respectively. The expected means of the log excess return of the risky assets depend on the prices of the respective good. Consequently the variances and covariances are also affected by trade policy. Thus the portfolio shares depend indirectly on trade policy.

I find that the tariff impact on the variables depends on variations in the asset correlation, the presence or absence of correlated income risk and the industry the labor income is generated in. Additionally the tariff impact depends on the total risk share existing in the portfolio.

To analyse the tariff impact on the asset allocation of the worker in detail I derive the total differential of the asset demand. It shows that the impact of trade policy on the asset demand for asset  $x$ <sup>18</sup> is not unambiguous<sup>19</sup>

$$(20) \quad \frac{\partial \alpha_{x,t}}{\partial \tau_{x,t+1}} = \frac{\partial \alpha_{x,t}}{\partial \mu_x} \frac{\partial \mu_x}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma_x^2} \frac{\partial \sigma_x^2}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma_{x,y}} \frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma_{x,l}} \frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}}.$$

(+)
(+)
(-)
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In (20) the tariff impact on the expected mean and the variance as well as the demand reaction of these two variables can be unambiguously signed. The effects on the asset covariance and the asset labor covariance can go either way. Obviously the first two components of  $\alpha_{x,t}$  both depend positively on the tariff. In the case of the expected mean this direction of the dependency might be expected but for the variance of the return of asset  $x$  this is somewhat surprising and will be discussed later on.

The positive impact of the tariff in industry  $x$  on the expected mean of asset  $x$

$$(21) \quad \frac{\partial \mu_x}{\partial \tau_{x,t+1}} = q_x^s \frac{r_{x,t+1}}{r_{x,t+1}^\tau + 1} > 0$$

results in a higher capital payment out of a higher profit. This is intuitiv as the protected industry faces higher output prices on the market for consumption goods. Precisely the tariff impact on  $\mu_x$  depends on the weighted ratio between the capital income without a

<sup>18</sup>analog for asset  $y$

<sup>19</sup>The sign in the paranthesis below the equations stands for the sign of the respective derivation.

tariff to the capital wealth in case of the tariff. This in turn leads to a higher return for the capital for every  $\phi_{x,t+1}^s$ . However the marginal impact of a rising tariff on  $\mu_x$  decreases.

Referring to (18)  $\alpha_{x,t}$  increases unambiguously in the mean. Hence the cumulative effect of the trade policy and the expected mean of asset  $x$  on the asset demand for asset  $x$  is positive.

The tariff impact on the variance of asset  $x$  is

$$(22) \quad \frac{\partial \sigma_x^2}{\partial \tau_{x,t+1}} = 2q_x^s (1 - q_x^s) \frac{r_{x,t+1}}{r_{x,t+1}^\tau + 1} \delta_{x,t+1}^\tau > 0.$$

Since  $q_x^s$  is always lower than one the inequality (22) is valid. The tariff impact is similar to the impact on  $\mu_x$ . Additional weights as the log dividend paid in industry  $x$  in the state of tariff and  $(1 - q_x^s)$  are added. So the variance for asset  $x$  rises with the tariff in sector  $x$ . Again the further marginal impact of  $\tau_{x,t+1}$  on  $\sigma_x^2$  decreases.

To understand this relation it is important to keep in mind that the economy is open and small. Thus the price level in the home country is fixed by the world price. The only variations in the home country result from the productivity shocks  $\phi_{x,t+1}^s$  and the introduction of a tariff in industry  $x$  is an additional possible variation which even reinforces the existing productivity shock.

Actually the impact of  $\sigma_x^2$  on  $\alpha_{x,t}$  is not always unambiguous. The size of the covariance and the risk aversion determine the sign of the reaction of  $\alpha_{x,t}$  on  $\sigma_x^2$ <sup>20</sup>. As I assume a highly risk averse investor, the cases with an increasing asset demand in  $\sigma_x^2$  are ruled out. Thus in the following analysis a decreasing  $\alpha_{x,t}$  in  $\sigma_x^2$  is assumed<sup>21</sup>.

Thirdly for a complete solution of (20) the impact of the trade policy on the covariance

$$(23) \quad \frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}} = \sigma_x^2 \frac{r_{x,t+1}^\tau + 1}{r_{y,t+1}^\tau + 1} \frac{r_{y,t+1}^\tau}{r_{x,t+1}^\tau} - \sigma_y^2 \frac{\delta_{x,t+1}^\tau}{\delta_{y,t+1}^\tau} \geq 0$$

is needed. The possible solutions of the inequality are summarized in the tables 4.1 - 4.3 in appendix I. In particular this effect depends on the relation of the variances of the assets, on the realised productivity shock in each industry, on the relative prices of the two goods and finally on the factor-intensity in the respective industry. As good  $x$  is assumed to be the labor intensive good, only states in column two of the tables 4.1 - 4.3 are considered. Thus on the first glance it seems that a negative tariff impact on the asset covariance is more likely than a positive effect.

Nevertheless the relation of the productivity shocks and the relative prices of the goods can turn the tariff impact on the covariance. Resulting from the underlying assumptions the productivity-shock relation can be determined more closely: As expected the industry with a productivity advantage will be the exporting industry, I only analyse the states

<sup>20</sup>All possible constellations are summarized in the tables 1.1 - 1.2 in Appendix I.

<sup>21</sup>Here the empirical evidence is pretty interesting. Regardless of the correlation between the asset returns Goetzmann and Kumar (2002) find empirical evidence for investors' behavior in the opposite directions. These investors reduce their total portfolio risk by adding more risky assets to their portfolio. In particular Goetzmann and Kumar (2002) use different measures of diversification. One of these measures, the normalised version of the portfolio variance shows two possibilities to reduce the risk of an individual portfolio. The first possibility of risk reduction is to increase the number of assets in the portfolio and the second to choose assets according to their negative correlations.

with a higher productivity shock for industry  $y$  than for industry  $x$ . Therefore only column two in table 4.3 is necessary for the further analysis.

Again the reaction of the asset demand of asset  $x$  can not be determined. The size of  $\sigma_x^2$  and the total risk share in the portfolio  $f$  influence the demand reaction on the asset covariance<sup>22</sup>.

Lastly the asset labor covariance is analysed

$$(24) \quad \frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}} = \sigma_l^2 \frac{r_{x,t+1}}{r_{x,t+1}^\tau + 1} \delta_{x,t+1}^\tau + \sigma_x^2 \frac{1}{1 + \tau_{x,t+1}} l_{x,t+1} \geq 0.$$

As long as the labor income is generated in the protected industry the tariff impact on  $\sigma_{x,l}$  is always positive. This might be surprising but referring to the tariff impact on the risk of asset  $x$  and the labor income respectively the positive impact on  $\sigma_{x,l}$  is confirmed. Both separated risks increase in the tariff. Hence if they are positively correlated it is obvious that the covariance is also positively affected by the tariff<sup>23</sup>. Moreover the tariff impact on  $\sigma_{y,l}$  is affected by the same factors covariance: correlation between the assets, productivity shocks, relative prices and factor intensity.

The asset demand reaction on  $\sigma_{x,l}$  depends further on the correlation between the asset return and the labor income. Thus a positive correlation between these variables reduces the respective asset demand and a negative correlation enforces it.

Above all the appearance of an idiosyncratic labor income risk reinforces the demand-dampening effect of the variance if an risk averse investor is assumed<sup>24</sup>. Based on the chosen utility function this coincides with the statement from Gollier (2001) that an independent background risk raises the aversion against the other risk source if the absolute risk aversion in the used utility function is decreasing and convex. Empirical evidence for this findings especially with uncertain labor income as the additional risk source is found by Heaton and Lucas (2000a) and (2000b).

### 5.1. Positively Correlated Sectors

In this section two different scenarios with two respective variations are analysed. Because the two risky assets and therefore the two industries are positively correlated the analysis of labor income generated in the not protected industry  $y$  is neglected. As my main interest lies on a working individual I assume a low portfolio risk in the portfolio. Hence the total risk share in the portfolio is  $f < \frac{1}{2}$ <sup>25</sup>.

#### Scenario Ia: worker in industry $x$ , strong risk decrease in industry $y$

I assume a positive correlation between the two industry sectors<sup>26</sup>. Furthermore a low total risk share in the portfolio  $f < \frac{1}{2}$  is given. As a result of the assumptions for this

<sup>22</sup>See tables 2.1 - 2.2 in appendix I for possible outcomes of  $\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,y}}$ .

<sup>23</sup>Krebs et al. (2005) find instead empirical evidence that in an economic boom the labor risk decreases with a reduced tariff rate. But the overall evidence for this risk behavior is rather weak.

<sup>24</sup>For the mathematical proof see appendix 3.

<sup>25</sup>For the portfolio decision with a high total risk share in the portfolio see appendix II.

<sup>26</sup>In particular the positive correlation of the asset returns in the two different industries can result from country shocks and a stronger receptivity of both assets to these shocks than to industry specific shocks. Thus the return development in both industries are synchronized to a certain level. The significance of different shocks (industry, country, global) and their impact on the return for different industries is

scenario three more derivations can be determined and (20) changes to

$$(25) \quad \frac{\partial \alpha_{x,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{x,t}}{\partial \mu_x}}_{(+)} \underbrace{\frac{\partial \mu_x}{\partial \tau_{x,t+1}}}_{(+)} + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_x^2}}_{(-)} \underbrace{\frac{\partial \sigma_x^2}{\partial \tau_{x,t+1}}}_{(+)} + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,y}}}_{(+)} \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_{(+)} + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,l}}}_{(-)} \underbrace{\frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}}}_{(+)}.$$

At first glance it might be surprising that the asset demand reacts positively on the asset covariance. But taking a closer look shows that this reaction results from a common portfolio-allocation motive. The worker has close preference concerning financial and labor income. Hence with a sufficient high industry risk he reduces his portfolio risk by increasing the number of assets in his portfolio<sup>27</sup>.

As the asset covariance is negatively affected by the trade policy the demand for asset  $x$  decreases in the asset covariance. There are three demand decreasing effects and they obviously compensate the positive effect caused by the raising expected excess return of asset  $x$ . Hence the demand for asset  $x$  decreases in the tariff.

The demand for asset  $y$  is analysed. A direct hedge of the labor risk is not possible as a positive correlated labor income risk is assumed. So a hedge can only take place via the asset covariance effect, thus  $\alpha_{y,t}$  should also rise in the asset covariance.

$$(26) \quad \frac{\partial \alpha_{y,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{y,t}}{\partial \mu_y}}_{(+)} \underbrace{\frac{\partial \mu_y}{\partial \tau_{x,t+1}}}_{(-)} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_y^2}}_{(-)} \underbrace{\frac{\partial \sigma_y^2}{\partial \tau_{y,t+1}}}_{(-)} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{x,y}}}_{(+)} \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_{(+)} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{y,l}}}_{(-)} \underbrace{\frac{\partial \sigma_{y,l}}{\partial \tau_{x,t+1}}}_{(-)}.$$

Two demand decreasing and two demand increasing effects arise in industry  $y$ . Firstly I observe the intra-industry effects and find that the decreasing risk is compensated by the decreased mean. Furthermore the asset covariance effect compensates the asset labor covariance effect. The worker neglects the labor risk hedge motive as both assets are positively correlated with the labor income. Hence the effects between the assets are heavier weighted than the labor risk effect. As a consequence the demand for asset  $y$  decreases in the tariff.

The worker in industry  $x$  faces a stronger risk than without a tariff. As a consequence he reduces his share of asset  $x$  in his portfolio. In industry  $y$  he observes a damped risk. Normally one might expect an increase in his share of asset  $y$ . But the industries are positively correlated. Thus a hedge of the industry  $x$  risk is not possible by rebalancing the portfolio towards asset  $y$ .

Therefore in the scenario with low total risk, positive asset correlation, labor income generated in the protected industry and a negative tariff impact on the asset covariance we observe a decreased exploitation of the asset market. Moreover there is no possible hedge of the labor risk even though there is no investment concentration.

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analysed for example in Brooks and Del Negro (2002) and (2005). For concrete examples see Costello (1993). She finds positive production and shock correlation between manufacturing industries for different countries.

<sup>27</sup>For empirical evidence of this investment behaviour see for example Goetzmann and Kumar (2002) or Massa and Simonov (2002) for the familiarity motive. Additionally Juillard (2004) shows this investor behaviour in a dynamic model of international portfolio diversification.

### **Scenario Ib: worker in industry $x$ , strong risk increase in industry $x$**

Repeating the same scenario above with a positive tariff impact on the asset covariance leads to weaker results. With a stronger risk increase in industry  $x$  than risk decrease in industry  $y$  the demand for asset  $x$  increases. However in this scenario it is not sure that the overall effect of the tariff will be positive. With the positive correlation between labor risk and asset risk, the asset covariance affects the asset demand stronger than the labor asset covariance. Furthermore with the low risk share in the portfolio the increased expected excess return compensates the increased asset risk. Hence the demand for asset  $x$  is more sensitive to the reduction of the risk in industry  $y$  and the increased mean in industry  $x$  than to the risk increase in the labor income. So the demand for asset  $x$  increases in the tariff.

However similar to the demand for asset  $x$ , the increase in the demand for asset  $y$  through the asset covariance has to compensate not only the decrease in the demand caused by the labor risk but also the impact of the decreasing expected excess return of asset  $y$ . Still the conditions are the same as above. Thus the demand for asset  $y$  can not be determined in case of a positive tariff impact on the asset covariance.

The total asset demand can not be determined unambiguously but the demand for asset  $x$  increases in the tariff. So there is a slight tendency towards a portfolio bias in favor of asset  $x$ . This can be justified by the reduction of the portfolio risk by increasing the number of assets. Though the concentration statement of Cassing (1996) is confirmed only warily, at least it can not be rejected. In addition the results do not support a decreased asset market exploitation as might be assumed by following Feeney and Hillmann (2004). Finally there is no possible labor risk hedge found in this scenario.

Here the additional risky labor income changes the results slightly. Without the labor risk the demand for asset  $y$  also increases in the tariff. So there is no investment concentration to be found. Furthermore the labor risk diminishes the exploitation of the asset market slightly.

Concluding I can say that independently of the total risky share  $f$  in the portfolio a hedge of the labor income is hardly possible as the two industries are positively correlated. Though an investment concentration can not be confirmed definitely yet, the asset market exploitation shows a slight tendency towards a reduction as a tariff is implemented in industry  $x$ .

## **5.2. Negatively Correlated Sectors**

In the case of negatively correlated sectors a change in the labor income correlation is very interesting. Hence in the following two scenarios are two respective variations discussed. Again the cases with a low total risk share in the portfolio are discussed and the cases with a high total risk share are analysed in the appendix II. The overall results in comparison to the results above are finally summarised in section 6.

### **Scenario IIIa: worker in industry $x$ , strong risk decrease in industry $y$**

In the following the changes in the asset demand are analysed in the state of a very low total risk share in the portfolio:

$$(27) \quad \frac{\partial \alpha_{x,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{x,t}}{\partial \mu_x}}_{+} \underbrace{\frac{\partial \mu_x}{\partial \tau_{x,t+1}}}_{+} + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_x^2}}_{-} \underbrace{\frac{\partial \sigma_x^2}{\partial \tau_{x,t+1}}}_{+} + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,y}}}_{-} \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_{-} + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,l}}}_{-} \underbrace{\frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}}}_{+}.$$

Here the hedging motive gains on weight. Thus the demand reaction changes with reference to the asset covariance. Hence with a negative tariff impact on the asset covariance two demand increasing and two demand decreasing effects face each other.

Firstly the three intra-industry effects are analysed. Two of them are demand decreasing and only the effect of the mean increases the demand of asset  $x$ . The mean effect is weakly stronger than the one of the demand decreasing effects. But the mean effect is not strong enough to compensate both of them together. Accordingly the total intra-industry effect decreases the demand of asset  $x$ .

Obviously the asset covariance effect has to compensate at least one of the negative intra-industry effects. The demand reaction on the asset covariance changes is higher than on variation in the risk of asset  $x$  as long as the total risky portfolio share still exceeds  $\frac{1}{2} \frac{1}{\gamma \rho}$ . However with the low total risk share this extra weight is very small. Besides the tariff impact on the asset covariance is weaker than on the risk of asset  $x$ . So a compensation for the asset covariance of the asset risk is not obvious.

The demand for asset  $x$  reacts more sensitive to changes in the labor asset covariance than to variations in the asset covariance. The labor risk gains on weight as the correlation of labor risk and asset risk with asset  $x$  are contrary. Additionally as I assume a working individual I implicitly assume a slightly higher consumption elasticity referring to labor income than to financial income. Consequently in the present scenario the worker weights labor effects more than the inter-industry effects<sup>28</sup>. The labor asset covariance increases in the tariff is stronger than the asset covariance decrease. Hence the total effect from the two covariances on the asset demand is negative and so the overall effect on  $\alpha_{x,t}$  can not be confirmed definitely.

With the low total risk in the portfolio the demand reactions for asset  $y$  also change and referring to modifications of condition (4) and condition (5)

$$(28) \quad \frac{\partial \alpha_{y,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{y,t}}{\partial \mu_y}}_{+} \underbrace{\frac{\partial \mu_y}{\partial \tau_{x,t+1}}}_{-} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_y^2}}_{-} \underbrace{\frac{\partial \sigma_y^2}{\partial \tau_{x,t+1}}}_{-} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{x,y}}}_{-} \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_{-} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{y,l}}}_{+} \underbrace{\frac{\partial \sigma_{y,l}}{\partial \tau_{x,t+1}}}_{+}$$

is to analyse.

Under the assumption of a stronger risk decrease in industry  $y$  than a risk increase in industry  $x$  the labor asset covariance as well as the asset covariance are negatively affected by the tariff. In contrast to the demand for asset  $x$  the demand effect on the labor asset covariance is weaker than on the asset covariance. As the correlations go in the same direction the compensation effects remain unchanged to the previous scenario. The changes induced by the tariff on the respective covariance are very close. So the overall effect of the inter-industry effects on the demand for asset  $y$  is positive.

<sup>28</sup>See Juillard (2004) for a similiar argumentation. He finds that a high liquid wealth - labor income ratio influence the portfolio-allocation towards a financial hedge and with a low ratio a labor risk hedge gains on weight.

Additionally the effect of  $\mu_y$  compensates the effect of  $\sigma_y^2$ . As the total risk share falls below one half the strength of the variance effect diminishes and the decreasing mean effect rises again. Hence the intra-industry effect is negative. Consequently the overall reaction of  $\alpha_{y,t}$  in  $\tau_{x,t+1}$  is not unambiguous.

Altogether in a scenario with a low total risky portfolio share, negative asset correlation, risky labor income generated in industry  $x$  and a stronger risk decrease in industry  $y$  than risk increase in industry  $x$  I find only a very slight tendency towards a decreasing total asset demand. Therefore the conclusions of a reduced asset market exploitation, no possible labor hedge and no investment concentration are rather weak. In comparison to a situation without risky labor income the tariff impact on the total asset demand and therefore the analysed consequences are reverted.

### **Scenario IIIb: worker in industry $x$ , strong risk increase in industry $x$**

Now I analyse the variation of scenario IV with a positive effect on the asset covariance. Here a demand decreasing effect arises for asset  $x$ . This is very intuitive as the positive tariff impact only occurs if the risk increase in industry  $x$  overcompensates the risk decrease in industry  $y$ . Hence the exposure to the intra-industry effects is higher than for inter-industry effects.

In the case of a positive tariff impact on the asset covariance the demand for asset  $y$  decreases. Consequently the labor asset covariance in industry  $y$  increases in the tariff as the risk increase in industry  $x$  exceeds the risk decrease in industry  $y$ . Correspondingly to the previous observations the tariff impact on both covariances is very close and the effect compensation is decided by the reaction of the demand of asset  $y$  on the respective covariances. As the overall conditions remain unchanged  $\alpha_{y,t}$  decreases in the total inter-industry effect. However the total intra-industry effect is the same as above.

In the scenario with a stronger risk increase in industry  $x$  than risk decrease in industry  $y$  the total asset demand is diminished by the tariff implementation in industry  $x$ . The worker reduces the share of asset  $x$  in his portfolio as a consequence of the strengthened risk in this industry. With the stronger covariance (less negative) the hedging possibility diminishes. Thus the worker also reduces his share of asset  $y$ .

Therefore I can confirm a definite loss on hedging possibilities for the labor risk accompanied by a reduction in the asset market exploitation. It is clear that there is no investment concentration observed as both asset demands decrease in the tariff. In this last case the additional labor risk does not change but strengthens the results.

Overall for scenario III with a low total risky portfolio share I find a loss of diversification possibilities caused by the tariff introduction. The labor risk hedge possibilities are reduced and the total asset demand decreases by the tariff introduction in industry  $x$ .

### **Scenario Va: worker in industry $y$ , strong risk decrease in industry $y$**

Now the asset demand in the case of a low total risk share is analysed. Following tables 1.2 and 2.2 obviously the signs for the labor asset covariance in the conditions for the demand dependencies change.

As the tariff impacts on the respective components of the asset demand remain un-



changed I start analysing the compensation effects between the components

$$(29) \quad \frac{\partial \alpha_{x,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{x,t}}{\partial \mu_x}}_+ \underbrace{\frac{\partial \mu_x}{\partial \tau_{x,t+1}}}_+ + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_x^2}}_- \underbrace{\frac{\partial \sigma_x^2}{\partial \tau_{x,t+1}}}_+ + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,y}}}_- \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_- + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,l}}}_+ \underbrace{\frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}}}_+$$

Firstly I analyse the two covariances. Under the assumption of a stronger risk decrease in  $y$  than the risk increase in  $x$  both covariances are negatively affected. The tariff impacts balance each other. Hence the demand reaction decides the compensation direction of one of the covariances over the other. However as the correlations of labor risk and asset  $y$  risk with asset  $x$  go in different directions, the compensation effect changes in comparison to the previous scenario. Thus the asset covariance dominates the labor asset covariances by influencing the demand of asset  $x$ . Hence the total inter-industry effect increases the demand for asset  $x$ .

Secondly I analyse the intra-industry effects. Actually the low total risk share in the portfolio influences the compensation effect significantly. Therefore the demand reacts stronger to changes in the mean again than to changes in the variance. Also the intra-industry effect on the asset demand is positive.

Consequently the demand for asset  $x$  increases in the tariff as the share of risky assets in the portfolio is below one half.

Similar to the asset demand in industry  $x$  the signs for the labor income risk correlation changes in industry  $y$ . Hence  $\alpha_{y,t}$  depends on the tariff as follows

$$(30) \quad \frac{\partial \alpha_{y,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{y,t}}{\partial \mu_y}}_+ \underbrace{\frac{\partial \mu_y}{\partial \tau_{x,t+1}}}_- + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_y^2}}_- \underbrace{\frac{\partial \sigma_y^2}{\partial \tau_{x,t+1}}}_- + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{x,y}}}_- \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_- + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{y,l}}}_- \underbrace{\frac{\partial \sigma_{y,l}}{\partial \tau_{x,t+1}}}_-$$

Following the steps in the analysis of  $\alpha_{x,t}$  the state with the strong risk decrease in industry  $y$  is observed. The tariff impact on the asset covariance as well as on the labor asset covariance is negative. Obviously the demand of asset  $y$  increases in  $\tau_{x,t+1}$ .

In this case asset  $x$  works as a hedging instrument. The negative tariff impact on the covariance does even strengthen this effect. Hence the worker increases his share of asset  $x$  firstly because of the increased return and secondly as a result of the hedging improvement. Further he increases his share of asset  $y$ . The risk reduction in all three risk components compensates the decreased return of this asset  $y$ . Hence he can reduce his portfolio risk by increasing the number of asset  $y$ . Thus the total effect of the tariff increases the overall asset demand. In a scenario with low total risk, negative asset correlation, labor income generated in the not protected industry and a negative tariff impact on the asset covariance a hedge of the labor income is definitely possible. Additionally I find an increasing total asset demand accompanied by no investment concentration in any industry.

### **Scenario Vb: worker in industry $y$ , strong risk increase in industry $x$**

The next variation of scenario VI considers a stronger risk increase in industry  $x$  than the risk decrease in industry  $y$ .

First I analyse the impact on  $\alpha_{x,t}$ . Hence both covariances in this industry increase in the tariff. Again the asset covariances dominates the labor asset covariance and therefore the total inter-industry effect of the tariff is negative. In contrast the intra-industry effect

remains unchanged. So the demand for asset  $x$  in dependence of the tariff in industry  $x$  can not be determined.

In the last step I analyse the impact on  $\alpha_{y,t}$ . In industry  $y$  the asset covariance increases in the tariff and the labor asset covariance shows the same effect as before. Again the labor asset covariance dominates the effect of the asset covariance. Thus a demand increasing effect is observed.

Similar to industry  $x$  the low total portfolio risk distorts the demand dependency towards the mean variations. Hence there is a total negative impact on the demand for asset  $y$  from there. Again a definite overall tariff impact on the demand of asset  $y$  can not be determined.

Now the hedging possibility is diminished and I find no definite reaction in the asset allocation of the worker.

Referring to the tariff impact in industry  $x$  and industry  $y$  with a low portfolio risk and a stronger risk increase in industry  $x$  than risk decrease in  $y$  no unambiguous direction of the total asset demand is determined. A income hedge is not clearly possible. Above all I can neither confirm nor reject any statement about asset market exploitation and investment concentration.

Summarising for the scenario with low portfolio risk, negative asset correlation and labor income generated in the not protected industry I find that a sufficient strong risk increase in industry  $x$  can diminish the asset market exploitation and therefore reduces the diversification possibilities. This in turn leads to reduced hedge of the labor risk.

## 6. Conclusion

From the present analysis four main components for a possible asset market exploitation and therefore a possible labor income hedge can be found. Firstly the already existing total risk share in the portfolio has a significant influence on the total asset demand. Secondly the tariff impact on the asset covariance is decisive for the asset allocation. Further the correlation between the two risky asset returns affects the labor income hedge under protectionist trade policy. Lastly it is important whether the risky labor income is generated in the protected industry or in the unprotected industry. All these different factors stand for different kind of risks and these various risk sources influence the investment decision of the individual in different ways.

The first three risk sources have ambiguous total effects on the investment and asset allocation decision of the worker. They differ in every isolated case.

But the location of the working income determines the impact of the trade policy on the individual investment and especially asset allocation decision significantly, particularly with regard to the worker with a low total risk share. Trade policy diminishes the total asset demand for a worker in the protected industry. For workers in the not protected industry protectionist trade policy leads to a slightly increasing asset demand. Consequently trade liberalization increases asset market activity especially in those countries with a representative investor working in the protected industry and tends to decrease asset market activity in countries with the representative worker in the not protected industries. These conclusions are only valid for investors with a low total risk share in their portfolio.

For the investor group with a high total risk share in the portfolio there is no unambiguous statement about the working location effect possible. One explanation is that investors with a high total risk share are usually relatively wealthy. With increasing wealth, more precisely with a high liquid wealth - labor income ratio, the labor hedge motive becomes less important and the financial hedge motive gains on weight. Hence the location of the working income has no crucial impact on their investment and asset allocation decision.

In particular the consequences of trade policy on the individual investment decision and thus considerations on the impact of overall employment can not be determined in general. The different country conditions and industry relations within this country have to be taken into account. Furthermore the characteristics of the different investor and employee groups determine strongest the final conclusion. If a government is interested in a certain level of asset market activities of a specific investor group trade policy and trade liberalization can be an additional stimulating instrument.

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## 8. Appendix I

### 8.1. Table 1: Impact of $\sigma_i^2$ on $\alpha_{i,t}$

(labor income positively correlated with asset  $i$ )

	$f > \frac{1}{2}$	$f < \frac{1}{2}$
$0 < \sigma_{x,y} < \left( \frac{1}{\gamma\rho}\mu_x - \frac{1-\rho}{\rho}\sigma_{x,l} \right) \frac{1}{f-\frac{1}{2}\frac{1}{\gamma\rho}}$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_x^2} < 0$	/
$0 < \sigma_{x,y} > \left( \frac{1}{\gamma\rho}\mu_x - \frac{1-\rho}{\rho}\sigma_{x,l} \right) \frac{1}{f-\frac{1}{2}\frac{1}{\gamma\rho}}$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_x^2} > 0$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_x^2} < 0$
$0 > \sigma_{x,y} < \left( \frac{1}{\gamma\rho}\mu_x - \frac{1-\rho}{\rho}\sigma_{x,l} \right) \frac{1}{f-\frac{1}{2}\frac{1}{\gamma\rho}}$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_x^2} > 0$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_x^2} < 0$
$0 > \sigma_{x,y} > \left( \frac{1}{\gamma\rho}\mu_x - \frac{1-\rho}{\rho}\sigma_{x,l} \right) \frac{1}{f-\frac{1}{2}\frac{1}{\gamma\rho}}$	/	$\frac{\partial\alpha_{x,t}}{\partial\sigma_x^2} > 0$

### 8.2. Table 2: Impact of $\sigma_{i,j}$ on $\alpha_{i,t}$

(labor income positively correlated with asset  $i$ )

	$f > \frac{1}{2}$	$f < \frac{1}{2}$
$\sigma_{x,y} > 0; \sigma_x^2 > \left[ \frac{1}{\gamma\rho}\mu_x - \frac{1-\rho}{\rho}\sigma_{x,l} \right] \frac{1}{(f-\frac{1}{2}\frac{1}{\gamma\rho})}$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_{x,y}} < 0$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_{x,y}} > 0$
$\sigma_{x,y} > 0; \sigma_x^2 < \left[ \frac{1}{\gamma\rho}\mu_x - \frac{1-\rho}{\rho}\sigma_{x,l} \right] \frac{1}{(f-\frac{1}{2}\frac{1}{\gamma\rho})}$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_{x,y}} > 0$	/
$\sigma_{x,y} < 0; \sigma_x^2 > \left[ \frac{1}{\gamma\rho}\mu_x - \frac{1-\rho}{\rho}\sigma_{x,l} \right] \frac{1}{(f-\frac{1}{2}\frac{1}{\gamma\rho})}$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_{x,y}} > 0$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_{x,y}} < 0$
$\sigma_{x,y} < 0; \sigma_x^2 < \left[ \frac{1}{\gamma\rho}\mu_x - \frac{1-\rho}{\rho}\sigma_{x,l} \right] \frac{1}{(f-\frac{1}{2}\frac{1}{\gamma\rho})}$	$\frac{\partial\alpha_{x,t}}{\partial\sigma_{x,y}} < 0$	/

### 8.3. Table 3: Impact of $\sigma_{i,j}$ on $\alpha_{j,t}$

(labor income positively correlated with asset  $j$ )

	$\sigma_{x,y} > 0$	$\sigma_{x,y} < 0$
$f < \frac{1}{\gamma\rho} \left( \frac{\mu_y}{\sigma_y^2} + \frac{1}{2} \right) - \frac{1-\rho}{\rho} \frac{\sigma_{y,l}}{\sigma_y^2}$	$\frac{\partial\alpha_{y,t}}{\partial\sigma_{x,y}} > 0$	$\frac{\partial\alpha_{y,t}}{\partial\sigma_{x,y}} < 0$
$f > \frac{1}{\gamma\rho} \left( \frac{\mu_y}{\sigma_y^2} + \frac{1}{2} \right) - \frac{1-\rho}{\rho} \frac{\sigma_{y,l}}{\sigma_y^2}$	$\frac{\partial\alpha_{y,t}}{\partial\sigma_{x,y}} < 0$	$\frac{\partial\alpha_{y,t}}{\partial\sigma_{x,y}} > 0$

### 8.4. Table 4: Impact of $\tau_{x,t+1}$ on $\sigma_{x,y}$

#### 8.4.1. Table 4.1: $\frac{\phi_x}{\phi_y} = 1$

$\frac{r_x(\tau)}{r_y(\tau)} \geq 1$	$\frac{\phi_x}{\phi_y} = 1 \wedge \frac{L_x/K_x}{L_y/K_y} = 1$	$\frac{\phi_x}{\phi_y} = 1 \wedge \frac{L_x/K_x}{L_y/K_y} > 1$	$\frac{\phi_x}{\phi_y} = 1 \wedge \frac{L_x/K_x}{L_y/K_y} < 1$
$\frac{p_x}{p_y} = 1$	/	$\frac{\partial\sigma_{x,y}}{\partial\tau_x} < 0$	$\frac{\partial\sigma_{x,y}}{\partial\tau_x} > 0$
$\frac{p_x}{p_y} > 1$	$\frac{\partial\sigma_{x,y}}{\partial\tau_x} < 0$	$\frac{\partial\sigma_{x,y}}{\partial\tau_x} < 0$	/
$\frac{p_x}{p_y} < 1$	$\frac{\partial\sigma_{x,y}}{\partial\tau_x} > 0$	/	$\frac{\partial\sigma_{x,y}}{\partial\tau_x} > 0$

**8.4.2. Table 4.2:**  $\frac{\phi_x}{\phi_y} > 1$

$\frac{r_x(\tau)}{r_y(\tau)} \geq 1$ $\frac{r_x(\tau)}{r_y(\tau)} < 1$	$\frac{\phi_x}{\phi_y} > 1 \wedge \frac{L_x/K_x}{L_y/K_y} = 1$	$\frac{\phi_x}{\phi_y} > 1 \wedge \frac{L_x/K_x}{L_y/K_y} > 1$	$\frac{\phi_x}{\phi_y} > 1 \wedge \frac{L_x/K_x}{L_y/K_y} < 1$
$\frac{p_x}{p_y} = 1$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} < 0$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} < 0$	/
$\frac{p_x}{p_y} > 1$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} < 0$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} < 0$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} < 0$
$\frac{p_x}{p_y} < 1$	/	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} < 0$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} > 0$

**8.4.3. Table 4.3:**  $\frac{\phi_x}{\phi_y} < 1$

$\frac{r_x(\tau)}{r_y(\tau)} \geq 1$ $\frac{r_x(\tau)}{r_y(\tau)} < 1$	$\frac{\phi_x}{\phi_y} < 1 \wedge \frac{L_x/K_x}{L_y/K_y} = 1$	$\frac{\phi_x}{\phi_y} < 1 \wedge \frac{L_x/K_x}{L_y/K_y} > 1$	$\frac{\phi_x}{\phi_y} < 1 \wedge \frac{L_x/K_x}{L_y/K_y} < 1$
$\frac{p_x}{p_y} = 1$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} > 0$	/	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} > 0$
$\frac{p_x}{p_y} > 1$	/	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} < 0$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} > 0$
$\frac{p_x}{p_y} < 1$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} > 0$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} > 0$	$\frac{\partial \sigma_{x,y}}{\partial \tau_x} > 0$

## 9. Appendix II

### 9.1. States with high portfolio risk

#### 9.1.1. Positively Correlated Sectors

##### Scenario IIa: worker in industry x, strong risk decrease in industry y

In this next scenario the total risky share is high  $f > \frac{1}{2}$  and  $\alpha_{x,t}$  decreases in  $\sigma_{x,y}$ . This leads to

$$(31) \quad \frac{\partial \alpha_{x,t}}{\partial \tau_{x,t+1}} = \frac{\partial \alpha_{x,t}}{\partial \mu_x} \frac{\partial \mu_x}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma_x^2} \frac{\partial \sigma_x^2}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma_{x,y}} \frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma_{x,l}} \frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}}.$$

(+)
(+)
(-)
(+)
(-)
(-)
(+)

It is obvious from (18) that the derivation of the asset demand for asset  $x$  for the covariance between asset  $x$  and the labor income is negative as long as the correlation between these components is positive. Thus an increase in the labor income risk reduces the demand for asset  $x$ . Furthermore with a positive correlation between the labor income and asset  $x$  the labor asset covariance is positively affected by the tariff:  $\frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}} > 0$ .

Therefore the total direct effect of the risky labor income on the demand for asset  $x$  is negative. This can be explained through the additional risk source argumentation by Bodie et al. (1992) and Gollier and Schlee (2004) and this argumentation will even be enforced by the positive correlation between the labor income and the return of asset  $x$ .

Besides the question is whether the analysed negative impact of the additional risk source on  $\alpha_{x,t}$  compensates the total previous positive effect of  $\tau_{x,t+1}$ .

Similar to a state without a risky labor income a negative impact of the tariff on the asset covariance is necessary for a positive total effect on the asset demand by the tariff. But this is not sufficient for the overall effect on  $\alpha_{x,t}$  and a more detailed analysis of the offsetting effects is needed.

With the total risk above one half

$$(32) \quad f > \frac{1}{2} \frac{1}{\gamma \rho}$$

is satisfied. Hence the demand for asset  $x$  reacts more sensitive to changes between the industries ( $\sigma_{x,y}$ ) than to intra-industry changes ( $\sigma_x$ ) and the decreasing  $\sigma_{x,y}$  stimulates

the demand for asset  $x$  more than the increasing risk of asset  $x$  decreases it. Moreover under the assumption of a moderate consumption elasticity referring to labor income the increasing mean compensates the increasing combined labor asset risk<sup>29</sup>. This leads to a positive overall effect on the demand for asset  $x$ .

As long as the two risky assets are positively correlated there is also a positive correlation between the risk of asset  $y$  and the labor income risk. Hence a direct hedge is not possible. However a risk reduction in terms of Goetzmann and Kumar (2002) is possible by increasing the number of the shares contained in the portfolio. So the demand for asset  $y$  does not necessarily decrease in the tariff

$$(33) \quad \frac{\partial \alpha_{y,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{y,t}}{\partial \mu_y}}_{(+)} \underbrace{\frac{\partial \mu_y}{\partial \tau_{x,t+1}}}_{(-)} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_y^2}}_{(-)} \underbrace{\frac{\partial \sigma_y^2}{\partial \tau_{x,t+1}}}_{(-)} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{x,y}}}_{(-)} \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_{(-)} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{y,l}}}_{(-)} \underbrace{\frac{\partial \sigma_{y,l}}{\partial \tau_{x,t+1}}}_{(-)}.$$

The lower direct risk of this asset and the decreasing effect on the asset covariance can enforce a higher asset demand. In contrast to asset  $x$ , expected mean of the log excess return of asset  $y$  decreases in the tariff. So in comparison to the asset shifting in the state without  $\tau_{x,t+1}$  the risk reduction has to compensate not only the labor risk but also a lower expected asset return. Furthermore it is important to note that the asset covariance is negatively affected by the tariff. Therefore the demand for asset  $y$  has also to depend negatively on the asset covariance for an overall positive effect<sup>30</sup>. Actually with a negatively affected asset covariance the asset-labor covariance in industry  $y$  has to be negatively affected, too. Hence all three risk effects pull in the same direction. This strong risk decrease in industry  $y$  compensates for the reduced expected excess return of asset  $y$ . So in spite of the positive correlated labor risk and the tariff introduction the demand for asset  $y$  increases with a tariff introduction in industry  $x$ .

Consequently in a scenario with high total risk, positive asset correlation, risky labor income generated in industry  $x$  and a stronger risk decrease in industry  $y$  than risk increase in industry  $x$  the introduction of a tariff in industry  $x$  does not cause a rebalancing of the portfolio towards asset  $x$ . In particular there is no investment concentration in the protected industry as Cassing (1996) states. Furthermore there is a possible hedge of the labor income in terms of Goetzmann and Kumar (2002). However I find no confirmation of a decreased asset market exploitation as a result of the tariff-introduction as would be the consequence of Feeney and Hillman (2004).

### **Scenario IIb: worker in industry x, strong risk increase in industry x**

For the sake of completeness a positive tariff impact on the asset covariance is considered. In this case the demand for both risky assets decreases in the tariff. Again the risky labor income has no significant influence on the results.

<sup>29</sup>A strong consumption elasticity referring to labor would distort the result in favor of the labor risk. In particular the increasing labor asset covariance would compensate the increased expected mean.

On the other hand a strong consumption elasticity referring to wealth would strengthen the observed result.

<sup>30</sup>The condition for a decreasing  $\alpha_{y,t}$  in  $\sigma_{x,y}$  is stated in table 2.2.

### 9.1.2. Negatively Correlated Sectors

#### Scenario IVa: worker in industry $x$ , strong risk decrease in industry $y$

Now the scenarios are analysed with negatively correlated industries. The impact of a tariff introduction in industry  $x$  on the total demand of asset  $x$  is analysed first for a total risk share in the portfolio above one half.

The impact of the tariff on the asset risk and the expected excess return remains unchanged. Equally their impact on the asset demand is analog to the previous section:

$$(34) \quad \frac{\partial \alpha_{x,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{x,t}}{\partial \mu_x}}_{(+)} \underbrace{\frac{\partial \mu_x}{\partial \tau_{x,t+1}}}_{(+)} + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_x^2}}_{(-)} \underbrace{\frac{\partial \sigma_x^2}{\partial \tau_{x,t+1}}}_{(+)} + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,y}}}_{(-)} \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_{(+)} + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,l}}}_{(-)} \underbrace{\frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}}}_{(+)}.$$

Two asset demand enhancing effects face two asset demand decreasing effects. With the high total riskshare in the portfolio (32) is satisfied and the demand reaction is stronger for changes in  $\sigma_{x,y}$  than in  $\sigma_x^2$ . Further the asset demand reacts more sensitive to variations in the mean than to variations in the asset labor covariance as long as the consumption elasticity to labor is moderate that is if

$$(35) \quad \frac{1}{\gamma} > (1 - \rho)$$

hold. The tariff impacts on the mean and the asset labor covariance are very close. Thus the demand reaction decides between these two effects. Overall  $\alpha_{x,t}$  increases in the tariff as the two positive effects outweigh the negative ones. But this compensation is very weak. The additional source of risk through the risky labor income distorts the tariff impact towards a decreasing demand for asset  $x$ . This distortion is not strong enough to compensate the two positive effects, however.

In contrast to the demand for asset  $x$  the demand of asset  $y$  increases in  $\sigma_{y,l}$ . Precisely as the risk of asset  $y$  and the labor income are negatively correlated asset  $y$  represents a hedge possibility for the labor risk. Moreover there is the possibility for a change of the tariff impact on the asset labor covariance because the two sources of risk are differently affected by the tariff. So the final effect is positive if the risk decrease in industry  $y$  is weaker than the risk increase in the labor income generated in industry  $x$ . Moreover the final effect changes if the strength ratio of these subeffect changes.

Again in common with the state without the labor risk the effect on the mean in industry  $y$  and the demand reaction on the mean are unchanged. But with the additional risk source  $\sigma_y^2$  gains importance.

Hence two effects determine the final effect on the demand of asset  $y$ , namely the tariff impact on the asset covariance and on the labor asset covariance.

$$(36) \quad \frac{\partial \alpha_{y,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{y,t}}{\partial \mu_y}}_{+} \underbrace{\frac{\partial \mu_y}{\partial \tau_{x,t+1}}}_{-} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_y^2}}_{-} \underbrace{\frac{\partial \sigma_y^2}{\partial \tau_{x,t+1}}}_{-} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{x,y}}}_{-} \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_{-} + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{y,l}}}_{+} \underbrace{\frac{\partial \sigma_{y,l}}{\partial \tau_{x,t+1}}}_{+}.$$

Firstly the tariff impact on the asset covariance is derived to be negative. As the risk decrease in asset  $y$  is much stronger than the risk increase in the labor risk the overall effect on the labor asset covariance is negative, too. Hence the total effect on the asset demand is unclear.



Comparing the intra-industry effects with each other and the inter-industry effects shows that the tariff impact on the mean and on the variance are very close. But  $\alpha_{y,t}$  reacts more sensitive to the variations in  $\sigma_y^2$  as in  $\mu_y$ . Hence the total intra-sectoral effect on the demand of asset  $y$  is determined by the variance and is therefore positive.

Analysing the inter-sectoral effect shows that the tariff impact on these components is also very similar. Thus the determination has to follow from the demand reaction on the components. Here the asset covariance overcompensates the labor asset covariance. Consequently the total inter-sectoral effect increases the demand for asset  $y$ .

Finally the total effect of the tariff on the demand of asset  $y$  is positive.

The worker does not rebalance his portfolio completely towards asset  $y$ . His allocation of asset  $x$  is not definite. But he increases his share of asset  $y$  as it works as a hedging instrument of the strengthened risk in industry  $x$ .

Even though the additional risk from labor income dilutes a definite asset demand increase in the tariff in industry  $x$ . In the scenario with a high risk share in the portfolio, negative correlated assets, labor income generated in industry  $x$  and a stronger risk decrease in industry  $y$  than risk increase in industry  $x$  the total asset demand does not necessarily decrease as the asset allocation is biased towards asset  $y$ . In particular the portfolio will be fairly biased towards asset  $y$ . Also I find a investment concentration in the not protected industry which is in contrast to the findings of Cassing (1996). As a consequence of this result a labor risk hedge is given. Eventually the results do not confirm a reduced use of the asset market.

#### **Scenario IVb: worker in industry x, strong risk increase in industry x**

The variation of scenario III with a positive tariff impact on the asset covariance shows that the demand decreasing effects for asset  $x$  are stronger than the demand enhancing effects. Thus the demand for asset  $x$  decreases in the tariff in this case. Moreover as  $\sigma_{y,l}$  increases in  $\tau_{x,t+1}$  the demand for asset  $y$  decreases in the tariff, too. Referring to the findings above the asset covariance effect overcompensates the labor asset covariance. The two demand decreasing effects are not compensated by the increasing effect resulting from the reduced risk in industry  $y$ . Hence  $\alpha_{y,t}$  falls as a tariff in industry  $x$  is introduced.

With the stronger risk in industry  $x$  the worker reduces both shares of the risky assets in his portfolio. He reduces asset  $x$  as the risk effect compensates the increased return. The hedging property of asset  $y$  is reduced with the less negative asset covariance.

Again a definite statement about a change in the total asset demand is not possible. Referring to the symmetry between the two risky assets in the model does not reject the assumption of a stable total asset demand. In particular a portfolio rebalancing towards asset  $x$  might be a possible consequence of the tariff introduction in industry  $x$ . Yet the concentration result of Cassing (1996) can not be confirmed. So the possibility for a real labor risk hedge diminishes and the diversification possibilities on the asset market are no longer exploited.

#### **Scenario VIa: worker in industry y, strong risk decrease in industry y**

Lastly I analyse the constellation where labor income is generated in the not protected industry of the home country. Hence the labor income and the return of asset  $x$  are negatively correlated whereas the correlation between the labor income and the return of

asset  $y$  is positive. Furthermore the asset correlation is still negative.

With a total risk share in the portfolio above one half the demand for asset  $x$  still depends negatively on the asset risk and also negatively on the asset covariance. The results in table 2.2 are even enforced since the sign for the labor asset covariance changes. Therefore the two risks can be higher than in the case with positive labor correlation and still the demand dependency does not change.

Nevertheless the demand dependency on the labor asset covariance changes. As asset  $x$  now serves as a hedging instrument for labor income the demand for asset  $x$  increases in the labor asset covariance. Hence the tariff impact on the demand for asset  $x$  is

$$(37) \quad \frac{\partial \alpha_{x,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{x,t}}{\partial \mu_x}}_+ \underbrace{\frac{\partial \mu_x}{\partial \tau_{x,t+1}}}_+ + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_x^2}}_- \underbrace{\frac{\partial \sigma_x^2}{\partial \tau_{x,t+1}}}_+ + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,y}}}_- \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_- + \underbrace{\frac{\partial \alpha_{x,t}}{\partial \sigma_{x,l}}}_+ \underbrace{\frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}}}_+$$

The only signs to determine are the changes in the inter-industry effects caused by  $\tau_{x,t+1}$ . First I observe a negative tariff impact on the asset covariance. This implies a stronger risk decrease in industry  $y$  than risk increase in industry  $x$ . Thus the sign for the reaction of the labor asset covariance is negative, too.

The intra-industry effects are very easily analysed as the tariff impact on both is similar. Besides the demand does react no longer stronger to the mean than to the variance. The high total risk and the additional risk sources have improved the strength of the asset risk in the determination of  $\alpha_{x,t}$ . Finally the total overall intra-industry effect decreases the demand for asset  $x$ .

Now the inter-industry effects are analysed. The tariff impact on the two covariances is very close. Again the effect determination is decided by the demand reaction on both. Therefore the overall inter-industry effect on the demand for asset  $x$  is positive as the asset covariance influences the asset demand stronger than the labor asset covariance.

Concluding the total tariff impact on  $\alpha_{x,t}$  in the state with high total risk, negative asset correlation and negative labor correlation is not determined.

For completeness the effects on the demand of asset  $y$  are analysed. With the positive labor income correlation in condition 4 and condition 5 the sign for the second term in the brackets changes. Additionally the demand reaction on the labor asset covariance also changes and now has a negative sign. The total tariff impact on the demand of asset  $y$  is now

$$(38) \quad \frac{\partial \alpha_{y,t}}{\partial \tau_{x,t+1}} = \underbrace{\frac{\partial \alpha_{y,t}}{\partial \mu_y}}_+ \underbrace{\frac{\partial \mu_y}{\partial \tau_{x,t+1}}}_- + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_y^2}}_- \underbrace{\frac{\partial \sigma_y^2}{\partial \tau_{x,t+1}}}_- + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{x,y}}}_- \underbrace{\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}}}_- + \underbrace{\frac{\partial \alpha_{y,t}}{\partial \sigma_{y,l}}}_- \underbrace{\frac{\partial \sigma_{y,l}}{\partial \tau_{x,t+1}}}_-$$

Following the previous section the stronger risk decrease in industry  $y$  is analysed and therefore both covariances are negatively affected. Obviously the tariff in industry  $x$  increases the demand of asset  $y$ .

The worker does not definitely rebalance his portfolio towards asset  $y$ . The industry risk and the labor risk dilute the financial hedging motive and the reallocation of asset  $x$  is not unambiguous. But the worker increases his share of asset  $y$ . As a result of the reduced risk he can reduce his portfolio risk by increasing the number of assets included.

Therefore the total asset demand might increase in the tariff if the demand for asset  $x$  remains stable. A definite statement is not possible as the direction of the demand

for asset  $x$  can not be finally determined. So for scenario Va with high portfolio risk, negative asset correlation, labor income generated in the not protected industry and a negative tariff impact on the asset covariance I state a slight investment concentration in the not protected industry - against the expectations in the literature. But I observe no definite decreasing asset market activities. Hence there might be a possible labor risk hedge. In comparison to the scenario with the labor income generated in the protected industry I find a dilution of the positive tariff impact on  $\alpha_{x,t}$  through the changed labor risk correlation. In contrast the positive tariff impact on  $\alpha_{y,t}$  is strengthened by the changed labor risk correlation.

### **Scenario VIb: worker in industry y, strong risk increase in industry x**

The next step is the analysis of a stronger risk increase in industry  $x$  than the decrease in  $y$ . Precisely both covariances are positively affected by the tariff. The effects on the demand remain unchanged. So the overall effect by the tariff obviously decreases the demand of asset  $x$ .

Further the demand for asset  $y$  is analysed as the risk increase in industry  $x$  exceeds the risk reduction in industry  $y$ . Consequently the tariff effect on the asset covariance increases in the tariff while the labor asset covariance does not change in reaction to the tariff. Once more the tariff impact on the covariances has a similar strength and the compensation has to be analysed over the demand impact. With the negative asset correlation and the positive labor risk correlation the labor asset covariance determines the effect on the demand of asset  $y$  of the two covariances. Hence the positive intra-industry effect compensates the negative inter-industry effect.

On the other hand the demand of asset  $y$  reacts more sensitive by changes in the asset risk as to the mean variations. The positively correlated labor income risk enforces this and the demand increasing effect caused by the variance changes dominates the demand decreasing effects by the mean. All effects together leads to a rising demand of asset  $y$  as the tariff in industry  $x$  is introduced.

In this case the worker decreases his share of asset  $x$  and increases the share of asset  $y$ . As the effect for asset  $y$  is the same as in the scenario above now in industry  $x$  the industry risk overcompensates the hedging possibility.

Finally a rebalancing of the portfolio towards asset  $y$  takes place as a positive tariff in industry  $x$  is introduced. A definite statement about a sufficient use of the asset market and therefore a labor risk hedge is not possible.

However in scenario V with a high total risk share, negative asset correlation and labor income generated in the not protected industry I find an investment concentration in the not protected industry. Furthermore a definite statement about a labor hedge and the asset market exploitation is not possible. These results are independent of the tariff impact on the asset covariance.