Trade Policy and Risk Diversification

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Abstract

This paper analyses the influence of trade policy on the investment decisions of working individuals. In particular, the 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, an effective hedge for the income risk is not possible in most of the observed scenarios.
1 Introduction

Beginning in the mid 1960’s, we have witnessed an overwhelming and continuing trend towards globalization and free trade.\footnote{See for example Wei and Wu (2002).} Among many other institutions, the Doha round of World Trade Organizations has recently reiterated the call to lower trade barriers. Despite the numerous benefits of free trade, this kind of liberalization carries with it a loss of protection and subsequently higher profit risk for many sectors and their associated workforce.

Conversely, we can also observe an almost unbridled expansion of speculative financial markets.\footnote{For empirical evidence on this development see for example Prasad, Rogoff, Wei and Kose (2003).} Deregulated financial markets can act as tools to dilute financial and non-financial risk and thereby offer some form of insurance. Further, trade liberalization may also be linked to financial integration, analogous to the manner in which the novel risks introduced by trade liberalization are absorbed to varying degrees by financial markets. Svaleryd and Vlachos (2002) demonstrate this significant linkage in their empirical study of financial development in conjunction with trade liberalization. At the time, the authors were unable to conclusively determine a clear direction or propose an explanation for this observed dependency, a number of approaches have since been developed to offer insight into the forces jointly affecting trade liberalization and financial integration.\footnote{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 loose 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.}

Eaton and Grossman (1985) or Cole and Obstfeld (1991) make a case for financial openness enforcing the 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 a political economic approach how increasing risk diversification over asset markets reduces the demand for protectionist trade policy.

Based on these considerations, I conclude that the continuing trade liberalization strengthens the desire to diversify risk – especially labour income risk – through financial markets. This leads to the question whether protectionist trade policy therefore reduces individual diversification on the asset market. Moreover, a stronger dependence on personal labour income could result from a reduction in diversification opportunities, and I will examine whether this is indeed the case.

To answer these questions I observe the influence of trade policies on the investment decisions of a typical working individual. Contrary to the previously mentioned literature, I will look at trade policy as exogenous and endogenise the individual diversification decision on the asset market. Emphasis will be placed
on the effect of increasingly uncertain levels of future income on individual investment behaviour.

To assess how globalization influences the portfolio choice, I will explore the influence of exogenous trade policy on portfolio optimization. In addition, I will evaluate if a labour income risk hedge is still possible under a protectionist trade policy. In the following analysis, a working individual has the option to hedge his or her income risk by investing in two different risky assets and one risk-free asset. The two risky assets are shares in the industries 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 the deciding factor in the optimal portfolio-decision. Claims on future labour income are not tradable.

The investment decision of the working individual is mainly determined by the asset covariance and labour 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. In this regard, I can confirm and extend the findings of Mayer (1984). In addition, it appears that variations in the total risk share can dilute the results.

The introduction of an import tariff substantially impacts the utilization of the asset market as well. Although the asset market does not lose its role as an insurance instrument completely, risk diversification via the asset market diminishes considerably as a consequence of tariff implementation. In contrast to Cassing (1996), I see no definite investment concentration in the protected sector. On the contrary, I can observe a portfolio bias towards the unprotected industry.

The paper is organized based on the following sub-topics. The next section provides a brief overview of relevant literature. Section three discusses the production side, and section four derives the individual portfolio decision. Section five analyses the optimal asset allocation of a working individual under a protectionist trade regime and the possible labour income risk hedge. Section six concludes the paper.

2 The Literature

Using the portfolio-theory, I will focus on the model elucidated by 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 risky assets are often neglected. In my analysis a 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 non-protected industry. Furthermore, the second risky asset allows 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 effects on productivity, ultimately resulting in prolonged employment, when workers 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 conclude that this results in an increased rate of employment as well.

The shifting results of additional capital income justify the variation of the income risk correlation. I will examine which of the investment alternatives will be preferred by the representative individual given the different trade regimes.

The third aspect discussed in the 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, as the opposite argument is valid 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. There is no decisive evidence for either of the arguments (Svalery and Vlachos (2002)).

In order to build on the existing literature, especially to the previously discussed strand, I will examine whether and how a protectionist trade regime changes the investment 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 disprove 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 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 differ 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.

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4Additional explanations for the liberalization of commodity trade as driving force of financial openness are found for example by Aizenman (2003).
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 labour 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 $\frac{p_{y,t}}{(1+\tau_{t,y})}$ respectively.

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

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

$K_{i,t}$ is the amount of capital and $L_{i,t}$ the amount of labour 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 joined 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 competition on product and factor markets the domestic income for labour and capital respectively is:

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

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

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 labour. 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, labour income $w_{i,t}$ is defined as in (2).

In addition to the labour 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 labour 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 risk free asset with constant return $r_f$. Therefore the total portfolio return in $t + 1$ will be

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

where

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

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, the portfolio return in $t + 1$ can be rearranged as

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

The risky asset returns and the portfolio return are assumed to be lognormally distributed\(^5\). 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

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

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

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

The labour income is also lognormally distributed and $l_{i,t+1} \equiv \ln w_{i,t+1}$ is the log labour income generated in sector $i$ with expected mean $\mu_i$ and variance $\sigma_i^2$\(^6\).

\(^5\)A lognormal distribution results if the variable is the product of a large number of independent, identically distributed variables, in this model $\delta_{i,t}$. Therefore the lognormal distribution is usually used to demonstrate asset return distribution. For further details see Aitchison and Brown (1973) or Pfäumer, Heine and Hartung (2001).

\(^6\)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. Considering a risk-averse individual with constant relative risk aversion coefficient \( \gamma > 1 \) close to Campbell and Viceira (2003)\(^8\). The individual has an initial endowment of wealth \( V_t \) in period \( t \) including the realised labour 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 \( t + 1 \):\(^9\)

\[
\max_{\alpha_{x,t}, \alpha_{y,t}} E_t \left[ \frac{C_{t+1}^{1-\gamma}}{1 - \gamma} \right]. \tag{9}
\]

subject to the budget constraint and referring to (6)

\[
C_{t+1} = V_t (1 + r_{p,t+1}) + w_{i,t+1}. \tag{10}
\]

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 labour income and the prevailing trade policy.

To obtain an analytical solution it is necessary to apply the log linear solution methods analogue 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

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

Further implementing a second-order Taylor expansion with two variables around the point \( \delta_{p,t+1} - \delta_f = 0 \) results in \(^{10}\)

\[
\delta_{p,t+1} = \alpha_{x,t} (\delta_{x,t+1} - \delta_f) + \frac{1}{2} \alpha_{x,t} (1 - \alpha_{x,t}) \sigma_x^2 + \alpha_{y,t} (\delta_{y,t+1} - \delta_f) + \frac{1}{2} \alpha_{y,t} (1 - \alpha_{y,t}) \sigma_y^2 + \alpha_{x,t} \alpha_{y,t} \text{cov} (\delta_{x,t+1}; \delta_{y,t+1}) + \delta_f. \tag{12}
\]

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\(^7\)Heaton and Lucas (2000b) use a similar life cycle model but with more than two periods. They set \( \gamma \) at 5 and 8 for a sufficient risk averse 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.

\(^8\)A similar model for a longer time horizon is used by Heaton and Lucas (2000b), to analyse the impact of background risk on the portfolio choice.

\(^9\)For the motivation to use this kind of utility function and its specific reaction to background risk see Gollier (2001).

\(^{10}\)For specific mathematic details see Appendix. For general discussions on this topic see Campbell and Viceira (2001) and Hardy and Walker (2003).
The next step is to log linearize the budget constraint. Hence both sides of (10) are divided by \( w_{i,t+1} \) and logs are taken

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

(13)

Thus the log optimal consumption

\[
c_{t+1} \approx g + \rho (v_t + \delta_{p,t+1}) + (1 - \rho) l_{i.t+1}
\]  

(14)

with \( g \) and \( \rho \) as log linearization constants can be derived\(^{11}\). \( \rho \)\(^{12}\) 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 labour income.

The log optimal future consumption is a weighted average of future financial wealth and future labour income each weighted with the consumption elasticity with respect to financial wealth and labour 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 labour 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 labour income are negatively correlated in the final portfolio decision\(^{13}\).

To reach the optimal portfolio decision the first order condition of the problem has to be observed\(^{14}\):

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

(15)

The first order condition shows that the expected total return of the investment from the value of \( C_{t+1} \) in industry \( x \) during period \( t \) has to be the same as the investment from the value of \( C_{t+1} \) 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 results in

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

(16)

\(^{11}\)For mathematic details see Appendix.

\(^{12}\)Per definition \( 0 < \rho < 1 \).

\(^{13}\)This impact of \( \rho \) on the consumption decision gains even more on interest if the labour decision is endogenized, by Jermann (1998).

\(^{14}\)This first order condition is confirmed by the general consumption decision model under uncertainty by Drèze and Modigliani (1972).
For simplicity the following observations are made for investments in industry $x$. But these observations and results are analogue for investment decisions in industry $y$. Now solving (16) for $\alpha_{x,t}$ leads to the asset allocation in industry $x$

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

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

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

where $f \equiv (1 - \alpha_{f,t})$. Hence, $f$ indicates the total proportion of risky assets in the portfolio\textsuperscript{15}. Obviously the optimal asset allocation for investments in industry $x$ can be divided into three components. The first term on the right corresponds to the decision of an investor in the standard mean-variance analysis\textsuperscript{16}. To see this connection more clearly it is important to reconsider an important property of a lognormal distributed variable, namely

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

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 $x$. Furthermore, the second risky asset and the labour 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 labour 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 $y$. Independent from 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.

\textsuperscript{15}In turn, $1 - f$ states the proportion of the risk free asset in the chosen portfolio.

\textsuperscript{16}For a detailed derivation of the mean-variance method see Markowitz (1987).
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 labour income risk. Following Feeney and Hillman (2004) an unrestrained access to asset markets lowers the individual demand for a protectionist trade policy. Furthermore, 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 sufficiently 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 claims 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 $p_{y,t+1}(1 + \tau_{x,t+1})$ 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 labour 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 $x$ is not unambiguous

$$
\frac{\partial \alpha_{x,t}}{\partial \tau_{x,t+1}} = \frac{\partial \alpha_{x,t}}{\partial \mu_x} \frac{\partial \mu_x}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma^2_x} \frac{\partial \sigma^2_x}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma_{x,y}} \frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma_{x,l}} \frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}}.
$$

In (20) the tariff impact on the expected mean and the variance as well as the demand reaction of these two variables can be signed unambiguously. The effects on the asset covariance and the asset labour 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.

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$^{17}$analogue for asset $y$  
$^{18}$The sign in the parentheses below the equations stands for the sign of the respective derivation.
The positive impact of the tariff in industry $x$ on the expected mean of asset $x$

\[
\frac{\partial \mu_x}{\partial \tau_{x,t+1}} = q_s^x \frac{\tau_{x,t+1}}{\delta_{x,t+1} + 1} > 0
\]

results in a higher capital payment out of a higher profit. This is intuitive 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 tariff to the capital wealth in case of the tariff. This in turn leads to a higher return for the capital for every $\phi_{x,t+1}$. 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

\[
\frac{\partial \sigma_x^2}{\partial \tau_{x,t+1}} = 2q_s^x (1 - q_s^x) \frac{\tau_{x,t+1}}{\delta_{x,t+1} + 1} \delta_{x,t+1} > 0.
\]

Since $q_s^x$ is always lower than one the inequation (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 $(1 - q_s^x)$ 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. So 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 $\delta_{x,t+1}$ 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 $\sigma_x^2$. 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.

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

\[
\frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}} = \sigma_x^2 \frac{\tau_{x,t+1}}{\delta_{x,t+1} + 1} - \sigma_x^2 \frac{\delta_{x,t+1}}{\delta_{y,t+1}} \geq 0
\]

19 All possible constellations are summarized in the tables 1.1 - 1.2 in Appendix I.
20 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, the second is to choose assets according to their negative correlations.
is needed. The possible solutions of the equation 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 labour 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 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\(^{21}\).

Lastly the asset labour covariance is analysed

\[
\frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}} = \sigma_x^2 \frac{r_{x,t+1}}{r_{x,t+1}^2 + 1} \delta_{x,t+1} + \sigma_x^2 \frac{1}{1 + \tau_{x,t+1}} l_{x,t+1} \geq 0. \tag{24}
\]

As long as the labour 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 labour 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\(^{22}\). 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 labour 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 labour income risk reinforces the demand-dampening effect of the variance if a risk-averse investor is assumed\(^{23}\). 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 these findings especially with

\(^{21}\)See tables 2.1 - 2.2 in appendix I for possible outcomes of \( \frac{\partial \sigma_{x,l}}{\partial \sigma_{x,y}} \).

\(^{22}\)Krebs et al. (2005) instead find empirical evidence that in an economic boom the labour risk decreases with a reduced tariff rate. But the overall evidence for this risk behavior is rather weak.

\(^{23}\)For the mathematical proof see appendix 3.
uncertain labour 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 labour income generated in the non-protected industry $y$ is neglected. As my main interest lies on a working individual I assume the portfolio risk to be low. Hence, the total risk share in the portfolio is $f < \frac{1}{2}$.

Scenario Ia: worker in industry $x$, strong risk decrease in industry $y$. I assume a positive correlation between the two industry sectors. Furthermore a low total risk share in the portfolio $f < \frac{1}{2}$ is given. As a result of the assumptions for this scenario three more derivations can be determined and (20) changes to

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

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 similar preference concerning financial and labour income. Hence, with a sufficiently high industry risk he reduces his portfolio risk by increasing the number of assets in his portfolio.

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 labour risk is not possible as a positive correlated labour 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

24 For the portfolio decision with a high total risk share in the portfolio see appendix II.

25 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 developments 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 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.

26 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.
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 labour covariance effect. The worker neglects the labour risk hedge motive as both assets are positively correlated with the labour income. Hence the effects between the assets are heavier weighted than the labour 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, labour 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 labour risk even though there is no investment concentration.

**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 labour risk and asset risk, the asset covariance affects the asset demand stronger than the labour 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 labour income. So the demand for asset $x$ increases in the tariff.

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 labour risk but also the impact of the decreasing expected excess return of asset $y$. Still, the conditions are the same as above. 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 favour 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 decreased asset market exploitation as might be assumed by following Feeney and Hillmann (2004). Finally there is no possible labour risk hedge found in this scenario.

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

Concluding I can say, that independent from the total risky share $f$ in the portfolio a hedge of the labour income is hardly possible as the two industries are positively correlated. Though an investment concentration can not be confirmed 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 labour income correlation is very interesting. 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 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:

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

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.

At first, 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 slightly stronger than the one of the demand decreasing effects. But the mean effect is not strong enough to compensate both of them. 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 the variation in the risk of asset $x$ as long as the total risky portfolio share still exceeds $\frac{1}{2} \frac{1}{\sigma^2}$. However, with the low total risk share this extra weight is very small. The tariff impact on the asset covariance is weaker than on the risk of asset $x$. Therefore, 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 labour asset covariance than to variations in the asset covariance. The labour risk gains weight as the correlation of labour 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 labour income than to financial income. Consequently, in the present scenario the worker weights labour effects more than the inter-industry effects\(^{27}\). The labour asset covariance increase 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 changes. Referring to modifications of condition (4) and condition (5)

\[
\frac{\partial \alpha_{y,t}}{\partial \tau_{x,t+1}} = \frac{\partial \alpha_{y,t}}{\partial \mu_y} \frac{\partial \mu_y}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma_y^2} \frac{\partial \sigma_y^2}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma_{x,y}} \frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma_{y,l}} \frac{\partial \sigma_{y,l}}{\partial \tau_{x,t+1}} \tag{28}
\]

has to be analysed.

Under the assumption of a stronger risk decrease in industry $y$ than a risk increase in industry $x$ the labour 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 labour 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 similar. So the overall effect of the inter-industry effects on the demand for asset $y$ is positive.

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 ambiguous.

Altogether in a scenario with a low total risky portfolio share, negative asset correlation, risky labour income generated in industry $x$ and a stronger risk decrease in industry $y$ than risk increase in industry $x$ I only find a very slight tendency towards a decreasing total asset demand. Therefore the conclusions of reduced asset market exploitation, no possible labour hedge and no investment concentration are rather weak. In comparison to a situation without risky labour 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 a variation of scenario IV with a positive effect on the asset covariance. Here a demand decreasing effect arises for asset $x$. This is very

\(^{27}\)See Juillard (2004) for a similar argumentation. He finds that a high liquid wealth-labour income ratio influence the portfolio allocation towards a financial hedge and with a low ratio a labour risk hedge gains on weight.
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 case of a positive tariff impact on the asset covariance the demand for asset $y$ decreases. Consequently, the labour asset covariance in industry $y$ increases in the tariff as the risk increase in industry $x$ exceeds the risk decrease in industry $y$. According to the previous observations the tariff impact on both covariances is very similar 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 labour 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 labour risk does not change but strengthens the results.

All in all, for scenario III with a low total risky portfolio share I find a loss of diversification possibilities caused by the tariff introduction. The labour 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 case of a low total risk share is analysed. According to tables 1.2 and 2.2, the signs for the labour asset covariance in the conditions for the demand dependencies change.

As the tariff impacts on the respective components of the asset demand remain unchanged, I start analysing the compensation effects between the components

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

First 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 change in demand decides the compensation direction of one of the covariances over the other. However, as the correlations of labour 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 labour asset covariances by influencing the
demand of asset \( x \). Hence, the total inter-industry effect increases the demand for asset \( x \).

As a second step, I analyse the intra-industry effects. The low total risk share in the portfolio influences the compensation effect significantly. Therefore the demand again reacts stronger to changes in the mean 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 labour income risk correlation changes in industry \( y \). \( \alpha_{y,t} \) depends on the tariff as follows

\[
\frac{\partial \alpha_{y,t}}{\partial \tau_{x,t+1}} = \frac{\partial \alpha_{y,t}}{\partial \mu_y} \frac{\partial \mu_y}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma^2_y} \frac{\partial \sigma^2_y}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma_{x,y}} \frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma_{y,l}} \frac{\partial \sigma_{y,l}}{\partial \tau_{x,t+1}}. \tag{30}
\]

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 labour 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 even stresses this effect. Hence, the worker increases his share of asset \( x \) because of the increased return and as a result of the hedging improvement. Then he increases his share of asset \( y \). The risk reduction in all three risk components compensates the decreased return of this asset \( y \). Therefore, 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, labour income generated in the non-protected industry and a negative tariff impact on the asset covariance a hedge of the labour income is definitely possible. Additionally I find an increasing total asset demand which is not accompanied by an 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 labour 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 \( x \) cannot 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 labour asset covariance shows the same effect as before. Again, the labour 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. An 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 labour income generated in the not protected industry I find that a sufficiently 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 labour risk.

6 Conclusion

From the present analysis four main components for possible asset market exploitation and therefore a possible labour 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. Furthermore, the correlation between the two risky asset returns affects the labour income hedge under protectionist trade policy. Lastly, it is important whether the risky labour 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 non-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 non-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 - labour income ratio, the labour hedge motive becomes less important and the
financial hedge motive gains 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.
7 References


8 Appendix I

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

<table>
<thead>
<tr>
<th>$\sigma_{x,y} &gt; 0$; $\sigma_i^2 &gt; \frac{1}{\gamma_p} \mu_x - \frac{1-\rho}{\rho} \sigma_x,l$</th>
<th>$f &gt; \frac{1}{2}$</th>
<th>$f &lt; \frac{1}{2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 &lt; \sigma_{x,y} &lt; \left( \frac{1}{\gamma_p} \mu_x - \frac{1-\rho}{\rho} \sigma_x,l \right) \frac{1}{f - \frac{1}{2}} \frac{1}{\pi}$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &lt; 0$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &gt; 0$</td>
</tr>
<tr>
<td>$0 &gt; \sigma_{x,y} &gt; \left( \frac{1}{\gamma_p} \mu_x - \frac{1-\rho}{\rho} \sigma_x,l \right) \frac{1}{f - \frac{1}{2}} \frac{1}{\pi}$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &gt; 0$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &lt; 0$</td>
</tr>
<tr>
<td>$0 &gt; \sigma_{x,y} &gt; \left( \frac{1}{\gamma_p} \mu_x - \frac{1-\rho}{\rho} \sigma_x,l \right) \frac{1}{f - \frac{1}{2}} \frac{1}{\pi}$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &gt; 0$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &gt; 0$</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>$\sigma_{x,y} &gt; 0$; $\sigma_{i,j}^2 &gt; \frac{1}{\gamma_p} \mu_x - \frac{1-\rho}{\rho} \sigma_x,l$</th>
<th>$f &gt; \frac{1}{2}$</th>
<th>$f &lt; \frac{1}{2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma_{x,y} &gt; 0$; $\sigma_{i,j}^2 &lt; \frac{1}{\gamma_p} \mu_x - \frac{1-\rho}{\rho} \sigma_x,l$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &lt; 0$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &gt; 0$</td>
</tr>
<tr>
<td>$\sigma_{x,y} &lt; 0$; $\sigma_{i,j}^2 &gt; \frac{1}{\gamma_p} \mu_x - \frac{1-\rho}{\rho} \sigma_x,l$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &gt; 0$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &lt; 0$</td>
</tr>
<tr>
<td>$\sigma_{x,y} &lt; 0$; $\sigma_{i,j}^2 &lt; \frac{1}{\gamma_p} \mu_x - \frac{1-\rho}{\rho} \sigma_x,l$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &gt; 0$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &lt; 0$</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>$f &lt; \frac{1}{\gamma_p} \left( \mu_x + \frac{1}{2} \right) - \frac{1-\rho}{\rho} \sigma_x,l$</th>
<th>$\sigma_{x,y} &gt; 0$</th>
<th>$\sigma_{x,y} &lt; 0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma_{x,y} &gt; 0$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &gt; 0$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &lt; 0$</td>
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<tr>
<td>$\sigma_{x,y} &lt; 0$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &lt; 0$</td>
<td>$\frac{\partial \alpha_{x,t}}{\partial \sigma_x} &gt; 0$</td>
</tr>
</tbody>
</table>

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

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

| \(\frac{r_x(r)}{r_y(r)} \geq 1\) | $\frac{\partial \sigma_{x,y}}{\partial r_x} = 1 \wedge \frac{L_x}{K_x} = 1$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} = 1 \wedge \frac{L_x}{K_x} > 1$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} = 1 \wedge \frac{L_x}{K_x} < 1$ |
|---------------------------------|-----------------|-----------------|
| $p_x \geq 1$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} = 0$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} < 0$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} > 0$ |
| $p_y > 1$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} < 0$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} < 0$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} > 0$ |
| $p_y < 1$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} > 0$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} < 0$ | $\frac{\partial \sigma_{x,y}}{\partial r_x} > 0$ |
### 8.4.2 Table 4.2: $\frac{\phi_x}{\phi_y} > 1$

<table>
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<tr>
<th>$\frac{r_x}{r_y} \geq 1$</th>
<th>$\frac{\phi_x}{\phi_y} &gt; 1 \land \frac{L_x}{K_x} \geq \frac{L_y}{K_y}$</th>
<th>$\frac{\phi_x}{\phi_y} &gt; 1 \land \frac{L_x}{K_x} &gt; \frac{L_y}{K_y}$</th>
<th>$\frac{\phi_x}{\phi_y} &gt; 1 \land \frac{L_x}{K_x} &gt; \frac{L_y}{K_y}$</th>
<th>$\frac{\phi_x}{\phi_y} &gt; 1 \land \frac{L_x}{K_x} &lt; \frac{L_y}{K_y}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_x$ (p_y) = 1</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &lt; 0$</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &lt; 0$</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>$p_x$ (p_y) &gt; 1</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &lt; 0$</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &lt; 0$</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &lt; 0$</td>
<td></td>
</tr>
<tr>
<td>$p_x$ (p_y) &lt; 1</td>
<td>/</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &lt; 0$</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &gt; 0$</td>
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</tr>
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### 8.4.3 Table 4.3: $\frac{\phi_x}{\phi_y} < 1$

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<th>$\frac{r_x}{r_y} \leq 1$</th>
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<th>$\frac{\phi_x}{\phi_y} &lt; 1 \land \frac{L_x}{K_x} &gt; \frac{L_y}{K_y}$</th>
<th>$\frac{\phi_x}{\phi_y} &lt; 1 \land \frac{L_x}{K_x} &gt; \frac{L_y}{K_y}$</th>
<th>$\frac{\phi_x}{\phi_y} &lt; 1 \land \frac{L_x}{K_x} &lt; \frac{L_y}{K_y}$</th>
</tr>
</thead>
<tbody>
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<td>/</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &gt; 0$</td>
<td></td>
</tr>
<tr>
<td>$p_x$ (p_y) &gt; 1</td>
<td>/</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &lt; 0$</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &gt; 0$</td>
<td></td>
</tr>
<tr>
<td>$p_x$ (p_y) &lt; 1</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &gt; 0$</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &gt; 0$</td>
<td>$\frac{\partial \sigma_{x,y}}{\partial r_z} &gt; 0$</td>
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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

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

(31)

It is obvious from (18) that the derivation of the asset demand for asset $x$ for the covariance between asset $x$ and the labour income is negative as long as the correlation between these components is positive. Thus an increase in the labour income risk reduces the demand for asset $x$. Furthermore with a positive correlation between the labour income and asset $x$ the labour 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 labour 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). This argumentation will even be enforced by the positive correlation between the labour 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 labour 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

$$
f > \frac{1}{2} \frac{1}{2 \gamma \rho}
$$

(32)

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 moderate consumption elasticity referring to labour income the increasing mean compensates the increasing combined labour asset risk\(^{28}\). This leads to a positive overall effect on the demand for asset $x$.

\(^{28}\)A strong consumption elasticity referring to labour would distort the result in favour of the labour risk. In particular the increasing labour asset covariance would compensate the increased expected mean.

On the other hand a strong consumption elasticity referring to wealth would strengthen the observed result.
As long as the two risky assets are positively correlated there is also a positive correlation between the risk of asset \( y \) and the labour 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

\[
\frac{\partial \alpha_{y,t}}{\partial \tau_{x,t+1}} = \frac{\partial \alpha_{y,t}}{\partial \mu_y} \frac{\partial \mu_y}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma_y^2} \frac{\partial \sigma_y^2}{\partial \tau_{y,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma_{x,y}} \frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma_{y,l}} \frac{\partial \sigma_{y,l}}{\partial \tau_{x,t+1}}. \tag{33}
\]

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 \( x \), the 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 labour 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\(^{29}\). Actually with a negatively affected asset covariance the asset-labour 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 labour 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 labour 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 labour income in terms of Goetzmann and Kumar (2002). However, I find no confirmation of 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 labour income has no significant influence on the results.

### 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

\(^{29}\)The condition for a decreasing \( \alpha_{y,t} \) in \( \sigma_{x,y} \) is stated in table 2.2.
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 analogue to the previous section:

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

Two asset demand enhancing effects face two asset demand decreasing effects. With the high total risk share 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 labour covariance as long as the consumption elasticity to labour is moderate; that is if

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

hold. The tariff impacts on the mean and the asset labour 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 labour 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 $\sigma_{y,t}$. Precisely, when the risk of asset $y$ and the labour income are negatively correlated asset $y$ represents a hedge possibility for the labour risk. Moreover, there is the possibility for a change of the tariff impact on the asset labour 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 labour income generated in industry $x$. Moreover, the final effect changes if the strength ratio of these sub effect changes.

Again in common with the state without the labour 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 labour asset covariance.

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

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 labour risk the overall effect on the labour 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 \( \sigma^2_{y,t} \) 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 over-compensates the labour 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 labour income weakens 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, labour 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); in consequence a labour 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 \( \sigma_{y,t} \) 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 over-compensates the labour asset covariance. The two demand decreasing effects are not compensated by the increasing effect resulting from the reduced risk in industry \( y \). Hence, \( \alpha_{y,t} \) decreases 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 labour 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 labour income is generated in the not protected industry of the home country. Hence the labour income and the return of asset x are negatively correlated whereas the correlation between the labour 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 labour asset covariance changes. Therefore, the two risks can be higher than in the case with positive labour correlation and still the demand dependency does not change.

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

$$\frac{\partial \alpha_{x,t}}{\partial \tau_{x,t+1}} = \frac{\partial \alpha_{x,t}}{\partial \mu_x} \frac{\partial \mu_x}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma^2_x} \frac{\partial \sigma^2_x}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma_{x,y}} \frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{x,t}}{\partial \sigma_{x,l}} \frac{\partial \sigma_{x,l}}{\partial \tau_{x,t+1}}. \quad (37)$$

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 labour 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 no longer react 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 labour asset covariance.

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

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

$$\frac{\partial \alpha_{y,t}}{\partial \tau_{x,t+1}} = \frac{\partial \alpha_{y,t}}{\partial \mu_y} \frac{\partial \mu_y}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma^2_y} \frac{\partial \sigma^2_y}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma_{x,y}} \frac{\partial \sigma_{x,y}}{\partial \tau_{x,t+1}} + \frac{\partial \alpha_{y,t}}{\partial \sigma_{y,l}} \frac{\partial \sigma_{y,l}}{\partial \tau_{x,t+1}}. \quad (38)$$

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 labour 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 fully determined. So for scenario Va with high portfolio risk, negative asset correlation, labour income generated in the non-protected industry and a negative tariff impact on the asset covariance I state a slight investment concentration in the non-protected industry - against the expectations in the literature. But I observe no definite decreasing asset market activities. Hence there might be a possible labour risk hedge. In comparison to the scenario with the labour income generated in the protected industry I find a weakening of the positive tariff impact on $\alpha_{x,t}$ through the changed labour risk correlation. In contrast, the positive tariff impact on $\alpha_{y,t}$ is strengthened by the changed labour 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 $y$. Both covariances are positively affected by the tariff. The effects on the demand remain unchanged. So the overall effect of the tariff obviously decreases the demand of asset $x$.

Furthermore, 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 labour 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 labour risk correlation the labour 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 labour 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 labour risk hedge is not possible.

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